Memoirs of the
NATIONAL MUSEUM
of Victoria

Number 37

Melbourne Australia 30 June 1976

Cover—An Obulkarra woman being painted with a clan design after death.

MEMOIRS

of the

NATIONAL MUSEUM OF VICTORIA

MELBOURNE AUSTRALIA

No. 37

PUBLISHED BY ORDER OF THE TRUSTEES
30 JUNE 1976

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CONTENTS

A REVISION OF THE GASTROPOD FAUNA OF THE LILYDALE LIMESTONE (EARLY DEVONIAN) OF VICTORIA

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Abstract

Thirteen species of gatsropods are described from the Lower Devonian Lilydale Limestone near Melbourne. Two of these are type species of the genera *Scalaetrochus* (*S. lindströmi* Etheridge) and *Gyrodoma* (*G. etheridgei* (Creswell)). Another two species *Michelia brazieri* (Etheridge) and in part *Straparollus* (*Euomphalus*) *northi* (Etheridge) are the type species for two now synonymized genera *Vetotuba* and *Liomphalus*. The other species are *Tremanotus pritchardi* Cresswell, *Bellerophon* (*B.*) *cresswell* Etheridge, *Phanerotrema australis* Etheridge, *Stenoloron subaequilatera* (Chapman), *Naticopsis* (*N.*) *lilydalensis* Cresswell, *Murchisonia* (*M.*) *pritchardi* (Etheridge), *Siluriphorus antiquus* (Cresswell), *Loxonema australis* (Chapman), and *Oriostoma rotundimuratus* sp. nov. Also described is *Michelia darwini* (de Koninck) from the Lower Devonian *'Receptaculites'* Limestone, Taemas, New South Wales. The genus *Boiotremus* Horny is considered to be a synonym of *Tremanotus* Hall.

The fauna which lacks platyceratids is associated with a diverse coral and stromatoporoid assemblage and depleted brachiopod fauna. The gastropod fauna possesses strong affinities with the Old World Realm faunas of Europe and North America, and also indicates a continuation into the Lower Devonian of certain typically Silurian forms.

Introduction

The gastropod fauna of the Lilydale Limestone was the subject of much attention by early palaeontologists in Australia. Robert Etheridge, Junr., in a series of papers (1890, 1891, 1894 and 1898) described three new genera, *Gyrodoma, Scalaetrochus* and *Vetotuba,* nine new species and noted the presence of an operculum in place in *Straparollus* (*Euomphalus*) *northi.* At about the same time the Rev. A. W. Cresswell (1885, 1893 and 1894), while noting the general elements of the fauna described four new species and noted the presence of an operculum in place in *S.* (*E.*) *northi.*

Soon after, Chapman (1916) reviewed the entire gastropod fauna. He described one new genus *Liomphalus,* six new species or varieties, and noted the presence of *Omphalotrochus globosum* (Schlotheim). Subsequently the fauna received very little attention. Knight (1941) reviewed the genera established by Etheridge and Chapman; Philip and Talent (1959) discussed *S.* (*E.*) *northi* and *Scalaetrochus lindströmi* and more recently Yochelson and Linsley (1972) discussed the opercula of *S.* (*E.*) *northi* and *Cyclonema lilydalensis.*

The gastropod fauna of the limestones in the Taemas region, N.S.W., has had a similar history of early attention and subsequent neglect. De Koninck (1876) described one new genus, *Mitchellia,* which Knight *et al.* (p. I301, 1960) synonymized with *Scoliostoma,* seven new species and noted the presence of six previously described species.

The basis of this study was the large collection of the National Museum of Victoria which has been collected over a period of more than seventy years. The bulk of this has come from the limestone where it has been the subject of Tertiary weathering (O. P. Singleton pers. comm.). Fortunately the weathering process preferentially destroys the matrix of the limestone before destroying the fossils. Thus at the right stage in this process when the matrix is soft the fossils can be obtained free of matrix and moderately well preserved. The remainder of the collection is preserved in a dense grey limestone.

Middle Palaeozoic gastropods have been the subject of relatively little recent study both in Australia and overseas. As a consequence many of the genera have been interpreted in a very loose sense. So much so, that quite frequently authors note that the species they are discussing, while being assigned to an established genus

in fact belongs to a new genus. In view of this, each of the species from Lilydale has been compared with the type species of the appropriate genus.

However, this has not been done with *Cyclonema australis* Etheridge and *C. lilydalensis* Etheridge, the two species of this genus described from Lilydale. It is generally recognized that the Devonian forms assigned to the genus *Cyclonema* in fact constitute at least one new genus (Thompson, 1970). To date no one has attempted to erect a new genus for these forms because a satisfactory basis for distinguishing it from *Cyclonema sensu stricto* is not readily apparent. However, the palaeoecological implications arising from the assignment of these species to the genus *Cyclonema* are quite erroneous. Thus the species from Lilydale are not redescribed here, rather it is intended that they should be the subject of another study. Also not described are members of the classes Monoplacophora, Polyplacophora, Pelecypoda, and Rostroconchia known to occur at Lilydale. These are to be the subject of another paper.

The generic ranges and distributions given by Knight *et al.* (1960) for the genera discussed here are accepted in general. Any amendment of this is based upon a *sensu-stricto* interpretation of the genus.

In this study the following abbreviations have been used: P: Palaeontological collection of the National Museum of Victoria; F.: Australian Museum, Sydney; M.U.G.D.: Melbourne University Geology Department; A.N.U.: Geology Department, Australian National University.

All measurements are in millimetres and the following symbols relating to the measurements have been used:

Clu, spiral sculptural elements above the selenizone.
Cll, spiral sculptural elements below the selenizone.
Hap, height of aperture.
Ht, total height of shell.
L, length measured at the selenizone in bellerophontids.
Lap, length of aperture.
Sw, selenizone width.
Wap, width of aperture.
Wlt, width at last trema.
Wt, total width of shell.
Wh, total number of whorls in shell.
*, specimen incomplete.

Acknowledgements

I wish to thank Dr A. Ritchie of the Australian Museum, Sydney, who made available Etheridge's type material; Mr M. Cooper of Melbourne University Geology Department, for the loan of specimens; Mr T. A. Darragh and Dr K. S. W. Campbell for critically reading this manuscript and their helpful comments and discussion; Dr O. P. Singleton for his discussion and comments throughout the course of this study; Margaret Tassell for her discussions and encouragement and Mr F. Coffa for the photographs.

Age of the Faunas

In the past, the age of the Lilydale Limestone has been the subject of some contention and frequent revision. Strusz (1972) assessed the evidence presently available from a number of groups and regarded the Lilydale Limestone as being Late Siegenian in age.

Strusz (1972) considered the '*Receptaculites*' Limestone at Taemas, in which *Michelia darwini* (de Koninck) occurs, to be Emsian in age.

However, Philip (1974) summarized recent developments in Europe which have placed the relationship of the stages in the different facies of the Lower Devonian in a state of flux. He commented, 'How sterile now seems the debates as to whether certain limestone horizons in eastern Australia are Siegenian or Emsian (or even Pragian) in age'. As yet the relationship of these stages in Europe has not been resolved.

This revision of the gastropod fauna makes little contribution to the age determination because of the present inadequate knowledge of gastropod faunas both in Australia and overseas. Most of the genera represented at Lilydale are characterized by such long ranges that they are of little value in age determinations. The remaining few genera with relatively short ranges such as *Scalaetrochus* are of limited value because of their restricted distribution.

Relationships of the Fauna

Representatives of eight gastropod superfamilies, murchisoniaceans, euomphalaceans, bellerophontaceans, pseudophoraceans, pleurotomariaceans, oriostomataceans, neritaceans and loxonemataceans are described from the limestone at Lilydale. As well as these there are the two species of turbiniform gastropods previously assigned to the genus *Cyclonema*.

Comparison with other Lower Devonian faunas in Australia is limited by the notable lack of recent studies. The closest fauna geographically that is described, is that of the Marble Creek Limestone (Talent and Philip, 1956). This fauna is dominated by platyceratids, although species of *Tremanotus* and *Michelia* are known at Marble Creek as well as Lilydale. Chapman (1907, p. 73) also noted the presence of *Scalaetrochus* sp., but this has not been subsequently verified.

The gastropod fauna from the limestones at Taemas, N.S.W., as described by de Koninck, has only a limited number of genera in common with Lilydale. *Michelia darwini*, described here, is very similar in shape to *M. brazieri* from Lilydale. Although de Koninck only described small bellerophontids from Taemas such as *Bellerophon convolutus* de Koninck, large forms comparable in size to *B.* (*B.*)*cresswelli* Etheridge are known to occur as well. Otherwise the gastropod faunas differ considerably, with Taemas possessing an abundance of small high spired forms, whereas such forms are generally absent at Lilydale.

Boucot (1975) summarized the now considerable amount of work on Devonian palaeogeography. During the Lower and Middle Devonian a very marked provincialism developed when compared with the preceding Silurian period and succeeding Late Devonian. This provincialism was greatest during the Siegenian, Emsian and Eifelian. During the Siegenian three realms, Malvinokaffric, Old World and Eastern Americas have been recognized, principally on the basis of brachiopods. Other groups including trilobites, corals and conodonts also support this biogeographic scheme. Within the Old World realm a number of regions or sub-provinces are recognized. It is within one of these, the Tasman sub-province, that Lilydale is located.

Boucot has observed that during 'the early Devonian the oriostomatids—poleumitids, tremanotids and euomphalids are present only in the Old World Realm as "Silurian holdovers" (relicts).' They also tend to be particularly characteristic of the Bohemian facies of the Old World Realm.

The gastropod fauna at Lilydale strongly supports this palaeobiogeographical scheme. Fifteen per cent of the fauna consists of relict genera *Tremanotus*, *Straparollus* (*Euomphalus*) and *Oriostoma*. These relict genera also tend to emphasize the greater similarity between Lilydale and the gastropods of the Bohemian facies, rather than with the sandier Rhenish facies of the Rhenish-Bohemian sub-province. The dextrally coiled *S.* (*E.*) *northi* is very like the similarly coiled *S.* (*E.*) *carnicus* (Frech) from the Carnac Alps. Also present in the Lower Devonian limestones of the Carnic Alps are species of *Bellerophon*, *Phanerotrema* and *Stenoloron* which are very similar to the species of these genera at Lilydale. Spitz (1907, pl. 13, fig. 16 a and b) illustrated a species of *Polytropis* from the Carnic Alps which is closely similar to the species assigned to *'Cyclonema'* at Lilydale. Jhaveri (1969) considered that the Carnic Alps gastropod fauna shows a close relationship with the gastropod faunas from the Lower Devonian of Bohemia, Northern France and New York as does the fauna from Lilydale.

Palaeoecology

Two gastropod groups dominate the fauna, the murchisoniaceans and the species of *'Cyclonema'*. They constitute about 31% and 25% of the fauna respectively. The euomphalaceans, bellerophontaceans and pseudophoraceans are the next most abundant groups in the fauna comprising 13%, 11% and 9% respectively. The remaining four superfamilies each comprise about 3% of the fauna.

In terms of general shape, the turbiniform to high spired forms comprise about 70% of

the fauna and the other 30% consists largely of discoidal and planispiral forms. About 80% of the fauna is either medium sized or large, although this may in part be an artifact of selective collecting. However, field comparisons of the abundance of smaller forms at Lilydale, Buchan and Taemas indicate a very much greater abundance at the latter two localities than at Lilydale.

At Lilydale the most distinctive feature of the fauna is the total absence of members of the Family Platyceratidae which is presently characterized by a cophrophagous mode of life. The two species of *'Cyclonema'* described from Lilydale possess an operculum (Yochelson and Linsley, 1972), lack any apertural or coiling irregularity and possess no other feature that could be suggestive of a cophrophagous mode of life. Thus their association with the platyceratidae would greatly distort any interpretation of the environment of the fauna.

Not only is there a general absence of platyceratids at Lilydale, there is also a general lack of crinoidal remains in the limestone. A significant percentage of the crinoidol remains present are composed of fragments of *Pernerocrinus* (Bates, 1972). This is in marked contrast to the gastropod fauna of the Marble Creek limestone. This latter fauna, dominated by platyceratids, occurs in a limestone composed in large part of crinoidal fragments. The fauna is also notable for its low taxonomic diversity in comparison with the diversity at Lilydale.

A similar situation is seen in the diversity of the gastropod fauna in the Silurian reefal complexes of Gotland, Sweden. The reefal limestones in which Manten (1971) observed gastropod faunas had a considerably more diverse fauna than that of the associated crinoidal limestones.

Linsley (1968) in his description of the Middle Devonian gastropods of the Anderdon Limestone recognized two principal habitats. One of these is a 'biostromal' environment where small snails lived on the carbonate mud flats between the corals and stromatoporoids in relatively shallow water. The gastropods of the other habitat, that of the 'inter-reef' lived on the carbonate muds developed between sparse, localized tetracoral assemblages. This fauna was distinguished by its considerably larger size, 1″-5″ being the maximum dimension. Also present were a few nautiloids, articulate brachiopods and some ostracodes. Linsley considered that the fauna and the sediment suggested a fairly quiet environment.

The composition of the fauna of Lilydale resembles reasonably closely the fauna of Linsley's inter-reef habitat. Both are dominated by large forms although more of these are high-spired types at Lilydale. However, the first species of *Scalaetrochus* to be recorded outside south-eastern Australia was described by Linsley from the Anderdon Limestone. Thus the similarity of sediment and fauna suggest that the gastropods of the Lilydale Limestone occupied an environment somewhat similar to the inter-reef environment of the Anderdon Limestone.

Yochelson and Dutro (1960) in their description of a Mississippian and Permian gastropod fauna from limestones in northern Alaska also made some comments on the palaeoecology of the assemblages. They observed that *'Platyceras* commonly occurs here in crinoidal limestones'. This is in accordance with its distribution in the limestones at Gotland, Marble Creek and Lilydale. Where *Platyceras* is common in the Lower Mississippian sediments, 'the associated gastropods show less variety than in the Upper Mississippian' (where *Platyceras* is less common). Again this is comparable with the situation at Lilydale and Gotland.

However, they noted that 'corals and gastropods also appear to be nearly mutually exclusive' and that 'gastropods are commonly associated with numerous taxonomically diversified brachiopods'. At Lilydale a situation quite the reverse exists. Gastropods and corals are very closely associated while only a depleted and restricted brachiopod fauna is present.

That such diverse gastropod associations exist only serves to emphasize the need for further work on this group before more meaningful generalizations on gastropod palaeoecology can be made.

Systematic Descriptions

Superfamily BELLEROPHONTACEA McCoy, 1851
Family SINUITIDAE Dall *in* Zittel-Eastman, 1913
Subfamily TREMANOTINAE Peel, 1972
Genus Tremanotus Hall, 1865
(= *Boiotremus* Horny, 1962).

Type Species: Tremanotus alpheus Hall, 1865; Middle Silurian; Bridgeport, Illinois, U.S.A.
Range: Middle Ordovician to Lower Devonian. The presence of *T. pritchardi* at Lilydale and *T. fortis* Frech and *T. insectus* Frech in the Upper Koněprusy Limestone, Koněprusy extends the upper range of the genus from Middle Silurian to Lower Devonian.
Discussion: Knight *et al.* (1960) provided a diagnosis for this genus in which the slit is 'represented by a row of tremata, all but the last few closed, not extending on to expanded lip'. Subsequently Horny (1963) amended this diagnosis to read, 'slit represented by a row of tremata in body whorls, not extending on the expanded lip; no tremata but shallow sinus in outer lip in young stages'. Horny (1962) also erected a new genus, *Boiotremus*, characterized by 'tremata present along the whole length of the whorls, periodical widened apertures after distances of 1-3 tremata'. It is into this latter genus that most of the species previously assigned to *Tremanotus* would be placed.

In his discussion of the genus *Tremanotus* he noted that the 'main and characteristic sign is the existence of the five opened tremata in the body whorl region. In the ontogenetically younger stage there are no tremata developed . . .' This interpretation is inconsistent with *T. alpheus* as described by Hall and Knight's (1941) redescription which Horny (1963, p. 97) suggested implicitly supported his case. Knight noted '6-8 tremata remaining open' and 'the earlier ones (were) filled'. That there are more than 5 tremata can be clearly seen in Knight's figures of the type species. The figures of Clarke and Ruedemann (1903) also clearly indicate that the presence of tremata is not confined to the body whorl. Unfortunately the preservation and orientation of the specimens figured by Horny does not show the dorsal surfaces of the earlier whorls.

Thus Horny's amendment of the diagnosis of *Tremanotus* is based upon a misconception and is without justification. The new genus *Boiotremus* to which he attributed 'all tremanotids' which have developed tremata during the whole life of the specimen, i.e. in all ontogenic stages' is thus a synonym of *Tremanotus*.

Horny (1963, p. 97) in his discussion of *Tremanotus* as redefined by himself, considered that both the tremata and the flared aperture were features which developed only at maturity. However, the development of the tremata was dependent upon the development of the flared aperture. This concept of the growth sequence with its inherent reorganization of the exhalent system is without justification because of the presence of tremata throughout the development of the entire shell.

Tremanotus pritchardi Cresswell, 1893 (Pl. 1, fig. 17)

1893 *Tremanotus pritchardi* Cresswell, p. 42, pl. 8, fig. 1.
1913 *Tremanotus pritchardi* Cresswell; Chapman, p. 227.
1916 *Tremanotus pritchardi* Cresswell; Chapman, p. 79 in part.

Diagnosis: Large form of genus in which the relationship between major growth rugae and tremata is variable; numerous fine growth lines and open tremata are present.
Description: Large planispiral gastropod with a widely expanded aperture in the final growth stage; wide umbilici; whorl profile gently arched dorsally, more strongly curved on the sides turning sharply into the wide and deep umbilici, flattened on the inner surface; aperture in final growth stage sub-oval; neither a sinus nor tremata are developed on the dorsal surface of the expanded region of the aperture; posterior to the expanded apertural region, the existence of a small sinus situated medially on the dorsal crest of the whorl is indicated by a slight posterior flexure of the growth lines; along the resultant selenizone numerous ovoid tremata are developed, the most anterior trema is represented by a solid protrusion over which growth lines pass; then follows a number of open tremata, up to 11, the tremata preceding

the open tremata are sealed and flush with the whorl surface; beween tremata the growth lines are directed posteriorly towards the earlier tremata; as well as the closely spaced growth lines, prominent growth rugae are developed; the relationship of the growth rugae to the tremata is variable; in some cases the rugae intersect the selenizone between tremata, in others at the trema; sculpture is composed of numerous spiral costae which arise in the umbilici; sculptural elements vary from one to three orders, sculpture and growth lines form a reticulate pattern over the entire whorl surface.

Dimensions:

	L	Wt	Lap	Wap	Wlt	Wh
M.U.G.D. 1666	92	56	46	43	35	5+
P914	—	47	43	40	33	—

Location of Types: Melbourne University Geology Department. Holotype, M.U.G.D. 1666 and counterpart M.U.G.D. 1667, G. B. Pritchard Coll.

Material: Holotype, counterpart, and 12 other specimens.

Discussion: This species is distinguished from the type species, *T. alpheus*, by having more open tremata, up to 11 as compared to the latter's 6 to 8. Transverse growth lines, principally fine ones of a type lacking in the American form, are more abundant. The relationship of the growth rugae and the tremata is quite variable in the Lilydale form. However, rugae only occur between tremata in the type species. The last potential trema is closed, whereas no mention of this was made by Knight (1941, p. 354) in his redescription of the type species.

Knight postulated that the tremata were formed during periods of growth when the flared aperture was not being deposited. At such times a shallow sinus in the outer dorsal lip formed a short slit, subsequently closed anteriorly by growth of the flared aperture. The flared aperture was then resorbed, the prominent growth rugae marking the point to which resorption occurred. This was followed by the initial growth type in which another trema was formed. This cycle was repeated numerous times as is indicated by the number of tremata.

Material from Lilydale suggests a mode of growth in *T. pritchardi* different from that postulated by Knight.

Initial growth, as in *Haliotis,* saw the development of a short sinus, which with subsequent growth of the apertural lips was closed, so forming a trema. Then followed a period in which only an exceedingly narrow and shallow sinus was developed. Subsequently this sinus deepened and another trema formed. With growth, earlier tremata were no longer required and sealed as in *Haliotis*. This process of growth continued until the animal reached its penultimate growth stage. At this point the mode of growth changed. No longer was a sinus formed. Rather the prominent flared aperture was developed. Frequently the sculpture present on the flared aperture is quite different to the rest of the shell, e.g. all but the first order spiral sculpture may be absent.

This growth cycle differs from that suggested by Knight, in that it does not require the flared

PLATE 1

Fig. 1 —*Michelia darwini* (de Koninck), ANU 36852, hypotype, Bloomfield Property, Yass, N.S.W., XI.

Fig. 2 —*Michelia darwini* (de Koninck), ANU 36853, hypotype, Bloomfield Property, Yass, N.S.W., XI.

Fig. 3 —*Michelia brazieri* (Etheridge), P1058, hypotype, XI.

Fig. 4 —*Loxonema australis* (Chapman), P38508, hypotype, XI.

Fig. 5 —*Michelia brazieri* (Etheridge), P1059, hypotype, XI.

Fig. 6 —*Bellerophon* (*Bellerophon*) *cresswelli* Etheridge, P12838, hypotype, X 2/3.

Fig. 7 —*Straparollus* (*Euomphalus*) *northi* (Etheridge), P28716, hypotype, X 2½.

Fig. 8 —*Straparollus* (*Euomphalus*) *northi* (Etheridge), P28714, hypotype, X 2/3.

Figs. 9-10—*Naticopsis* (*Naticopsis*) *lilydalensis* Cresswell, P37740, hypotype, XI.

Figs. 11-12—*Phanerotrema australis* Etheridge, F. 1332, syntype, X 1½ (approx.).

Fig. 13—*Scalaetrochus lindströmi* Etheridge, F.1137, holotype, X 2/3.

Fig. 14—*Stenoloron subaequilatera* (Chapman), P37643, hypotype, X 2/3.

Fig. 15—*Scalaetrochus lindströmi* Etheridge, F.1137, holotype X 2/3.

Fig. 16—*Scalaetrochus lindströmi* Etheridge, P38505, hypotype X 2/3. Basal view showing open umbilicus.

Fig. 17—*Tremanotus pritchardi* Cresswell, M.U.G.D. 1666, holotype, X 2/3.

Fig. 18—*Scalaetrochus lindstromi* Etheridge, F.1137, holotype, X 2/3. Basal view.


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aperture to be deposited and resorbed numerous times. Here the flared aperture is considered to be a gerontic feature. It is also considered that the type species mode of growth was the same as that of *T. pritchardi*.

In his discussion of *Boiotremus*, Horny (1963, p. 101) noted the presence of tremata throughout the entire life of the specimen and the development of periodically widened apertures. He did not describe the extent and nature of this 'periodical widened aperture'. That *Tremanotus* did not develop a large flared aperture periodically has been discussed earlier. Horny did not make mention of resorption of this widened aperture. The only other method of removal would be purely mechanical by abrasion. Whatever the method, the removal of this region results in the formation of a feature he termed a 'scar'. This is in fact the same as the major growth rugae observed in the type species and the species from Lilydale. As previously noted the distribution and degree of development of these growth rugae is quite variable amongst members of the same species and between different species. This is also true of the species figured by Horny.

Although Horny (1963) figured two specimens NM-L5727 and NM-L5729 (Pl. 26, fig. 2 and Pl. 27, figs. 2, 3, 4 and 5) which he considered show the widened aperture, these specimens could equally as well be mature specimens with badly damaged expanded apertural regions. Because of the great variability in the development of the growth rugae or 'scars' it is considered highly unlikely that the widened apertures as described by Horny were developed. To demonstrate their existence unequivocally would require a mature specimen with both the final expanded apertural region and the older widened apertures preserved. Their appearance would be much the same as varices of certain gastropods. If, in fact they do exist, their great variability as reflected by the growth rugae or 'scars' would make them unsatisfactory as a generic characteristic.

Chapman (1916, p. 79) mentioned a specimen from Marble Creek, Thomson River, Victoria. Subsequently Talent and Philip (1956) described a new species *T. cyclocostatus* from this locality. This is distinguished from *T. pritchardi* by its considerably smaller size and much finer growth lines and sculpture. It also has fewer foliaceous growth rugae and those that are present are irregularly developed.

Subfamily Bellerophontinae McCoy, 1851.

Genus Bellerophon Montford, 1808

Subgenus Bellerophon (Bellerophon) Montfort, 1808

Type Species: Bellerophom vasulites Montfort, 1808; Middle Devonian; The Eifel, Germany.

Bellerophon (Bellerophon) cresswelli Etheridge, 1891

(Pl. 1, fig. 6; Pl. 3, figs. 3, 4, 5, 6, 9)

1891 *Bellerophon cresswelli* Etheridge, p. 130, pl. 19, figs. 6-8.
1913 *Bellerophon cresswelli* Etheridge; Chapman, p. 227.
1916 *Bellerophon cresswelli* Etheridge; Chapman, p. 80, pl. 2, fig. 12, pl. 4, fig. 53.
1916 *Bellerophon pisum* Chapman, p. 80 pl. 2, figs. 9-11.

Diagnosis: Typical form of genus with thickened outer lip which extends posteriorly beyond the umbilical region; broadly crescentic aperture; selenizone only slightly elevated and bordered by two fine threads; sculpture composed of very fine transverse elements.

Description: Medium, subglobular, narrowly umbilicate planispiral gastropod with broad involute whorls; whorl profile gently arched dorsally, more strongly curved on the sides, turning sharply into the narrow umbilici; aperture very broadly crescentic; margin of outer lip not flared anteriorly but flared outward in the lateral and umbilical regions, margin continues across the parietal wall as a moderately thick inductura which thickens considerably towards the lateral margins, greatest thickness at the junction of the flared outer lip and parietal wall; narrow, moderately deep slit on outer lip generating a dorsal selenizone which is very slightly raised above the whorl surface and bordered by two very fine threads; sculpture consists of fine transvere growth lines with occasional growth rugae, holotype has about seven whorls.

Dimensions:

	L	Wt	Lap	Wap	Wh	Sw
F.1327	—	37	29	25	7	1
P293	48	47	23	41	—	0·6
P1087	11	10	3*	7·3	—	0·4
P12837	41	44	37	40	—	—
P12838	44	43	37	25*	—	1
P34938	12	12	3	9*	—	0·4

Location of Types: 1. *B. cresswelli*, Australian Museum, Holotype, F.1327. National Museum of Victoria, Hypotypes, P12838, P34938. G. Sweet Coll.

2. *B. pisum*, National Museum of Victoria, Holotype, P1087, A. W. Cresswell Coll.

Material: Holotype, 3 hypotypes and 37 other specimens.

Discussion: The holotype is partially broken, revealing the inner whorls which number about seven. This species is distinguishable from the similar sized type species *B. (B.) vasulites* by a number of features. The aperture of *B. (B.) cresswelli* is more broadly crescentic in shape. The outer lip is considerably thicker in the Lilydale form and extends further posteriorly beyond the umbilici. The selenizone of the type species is raised further above the whorl surface and bordered by shallow depressions rather than the fine threads of the Lilydale form. Transverse sculpture in *B. (B.) cresswelli* is considerably finer, particularly in the regions near the selenizone.

Chapman (1916, p. 80) referred to a well preserved specimen in the National Museum of Victoria collection which exhibits 'a faint but definite lattice structure of wavy striae across the growth lines'. However, none of the specimens examined in this study possess such ornamentation.

During growth *B. (B.) cresswelli* changed slightly in form. The aperture became more flared. In the juvenile form, flaring was confined to the umbilical region, but with growth the lateral areas of the outer lip also became flared. Initially quite thin, the inductura also thickened with growth, as did the outer lip. The influence of thickening is quite marked in the change of shape of the junctions of the parietal inductura and outer lip. In the juvenile forms, a marked, moderately deep channel is present, whereas in the older forms the channel is considerably shallower. The sculpture also changes from being quite wide, regular and nearly foliaceous in smaller forms to generally closer, finer but more irregular and variable in the larger forms.

Chapman (1916, p. 80) described *B. (B.) pisum* from Lilydale. He did not indicate specifically how it is distinguishable from this species. Presumably it is because of its smaller size, distinct sinus in the outer lip and sculpture of 'interrupted radial striae . . . between the lines of growth'. However, none of the features that Chapman mentioned in his description of *B. pisum* are unique. All these features are found in specimens of *B. (B.) cresswelli*, particularly the smaller forms. It is considered that *B. pisum* is a juvenile of *B. (B.) cresswelli.*

Superfamily EUOMPHALACEA de Koninck, 1881

Family EUOMPHALIDAE de Koninck, 1881

Genus Straparollus Montfort, 1810

Subgenus Straparollus (Euomphalus) J. Sowerby, 1814
(= *Liomphalus* Chapman, 1916)

Type Species: Euomphalus pentangulatus J. Sowerby, 1814; Lower Carboniferous; near Dublin, Ireland.

Discussion: Chapman (1916, p. 90) erected the genus *Liomphalus* which he distinguished from *Euomphalus* in having 'smooth rounded uniangulated whorls', and from *Straparollus* in possessing a concave spire. The genus is characterized by the following: discoidal; base concave; wide umbilicus; spire depressed; whorls smooth, sometimes with keel; whorls thicken progressively, in the late stages free or adpressed.

Knight (1941, p. 174) considered it 'utterly impossible to arrive at any comprehension of the genotype species except by comparison with the adequately described species of other authors referred by Chapman to his genus'. Later, Knight (1944, p. 465) placed it in synonomy with *Lytospira* Koken.

Philip and Talent (1959, p. 50) demonstrated that the genus *Liomphalus* is based on the internal moulds of *Straparollus* (*Euomphalus*) *northi* (Etheridge). Their conclusions

are amply supported by many specimens in the collections studied.

Straparollus (Euomphalus) northi (Etheridge), 1890

(Pl. 1, figs. 7, 8. Pl. 2, fig. 11. Pl. 3, figs. 1, 2, 7, 8)

1890 *Oriostoma northi* Etheridge, p. 64, pl. 9, figs. 6-7.
1894 *Oriostoma northi* Etheridge, p. 151, pl. 9, figs. 1-4.
1894 *Euomphalus* (*Oriostoma*) *northi* Etheridge; Cresswell, p. 157.
1913 *Euomphalus northi* (Etheridge); Chapman, p. 227.
1916 *Euomphalus northi* (Etheridge); Chapman, p. 90.
1916 *Liomphalus australis* Chapman, p. 90, pl. 4, figs. 32-33.
1959 *Straparolus* (*Euomphalus*) *northi* (Etheridge); Philip and Talent, p. 50, pl. 7, figs. 1-12, pl. 8, figs. 1-2.
1972 *Oriostoma northi* Etheridge; Yochelson and Linsley, p. 8, pl. 1, fig. 6, pl. 2, figs. 1-5.

Diagnosis: Dextrally coiled discoidal gastropod; variably developed angulations on upper and lower whorl surfaces; sculpture initially consists of strong transverse costae becoming less developed with growth.

Description: Medium to large discoidal dextral gastropod; numerous whorls with profile flat to gently convex and inward sloping between the upper suture and the variably developed upper keel at the junction of the upper and outer whorl surfaces; more than one keel may be developed on the upper surface; the prominence of the keel or keels tends to decrease with increased size; the junction of the outer and basal whorl surfaces is generally less pronounced than that for the upper surfaces; sutures impressed; base strongly arched; very wide umbilicus; spire depressed; aperture circular; columellar lip thin, concave parietal lip thin; outer lip slightly thicker and it extends outwards radially from the upper suture to the outer whorl surface where a mild concave flexure is sometimes developed, and then continues inwards across the base radially to the suture; no sinus or flexure of growth lines is developed at the keel, if present; sculpture is variably developed on specimens of different size and on the one specimen; the smaller specimens and the inner whorls of the larger specimens possess prominent transverse ridges; on the larger specimens, fine growth lines gradually succeed the prominent juvenile sculpture; sculpture on the base while similar to that on the upper and outer surfaces is less strongly developed; transverse partitions occur in early whorls; multispiral operculum of numerous fine whorls of variable thickness, circular in shape; whorls are normally visible on the plano-concave exterior surface; the concave internal surface is smooth being composed of laminae deposited nearly at right angles to the opercula rim; the degree to which the internal surface is concave is quite variable; a shallow central depression occupies about one-third of the inner surface; thickness is variable, even for opercula of the same diameter; operculum fits tightly in the aperture, being retracted into the shell for about 2 mm.

Dimensions:

	Ht	Wt	Hap	Wap	Wh
F.1321a	13·5	74	—	—	4
F.1139e	20·2	51	—	—	—
P1107	25*	71	23	23	4
P2503	—	54	—	—	3
P7609	—	60	—	—	—
P28373	32	97	—	—	—
P28498	19	63	—	—	4+
P28499	—	59	—	—	—
P28707	14	49	—	—	3+
P28711	25	77	—	—	4+
P28712	27	77	—	—	3+
P28714	16	44	—	—	4
P28716	10	19	—	—	4
P28719	7	14	—	—	—
P34300	27	54	—	—	4

Location of Types: 1. *Oriostoma northi,* Australian Museum. Holotype, F.1321a, Paratype, F.1139e. National Museum of Victoria. Hypotypes, P1107, P1115. A. W. Cresswell Coll. P26890, P28499, P28714, P28716, P28718, P28719. E. D. Gill Coll. and P34300-34302 which were formerly GSV 55329, 55330 and 55332.

2. *Liomphalus australis,* National Museum of Victoria. Holotype, P7609, Paratype, P2503. A. W. Cresswell Coll.

Material: Holotype, paratype, 13 hypotypes and 49 other specimens.

Discussion: Comparison of *S.* (*E.*) *northi* with the type species *S.* (*E.*) *pentangulatus* reveals a number of differences. The former has a shallower, wider umbilicus and is coiled dex-

trally. Its upper keel is less strongly developed and there is an absence of spiral sculptural elements. The sculpture of the Lilydale form is more variable; initially the transverse elements are much stronger than those of the type species but finally they are considerably weaker. The sculpture is also less evenly developed on the upper and basal whorl surfaces.

The dextral coiling of *S.* (*E.*) *northi* is also a feature of *S.* (*E.*) *carnicus* (Frech). As figured by Jhaveri (1969, pl. 21, fig. 8) this species also possesses strong transverse sculptural elements as does *S.* (*E.*) *northi*. It also probably possesses an operculum which is very similar to that of *S.* (*E.*) *northi*, (Yochelson and Linsley 1972, p. 9).

Yochelson and Linsley (1972, p. 8) described the operculum from *S.* (*E.*) *northi* and compared it with very similar types found in a number of other genera which belong to more than one family. Because of this they suggested implicitly that a revision of these families was needed. Thus they preferred to leave the species from Lilydale in the genus *Oriostoma* as originally determined by Etheridge. However, comparison of *S.* (*E.*) *northi* with *Oriostoma barrandei* Munier-Chalmas, the type species reveals sufficient differences to preclude it from belonging to the latter genus. *S.* (*E.*) *northi* is discoidal rather than turbiniform and has a much wider umbilicus. There is an absence of the spiral sculpture characteristic of the type species. The form from Lilydale has a more angular whorl profile and its aperture is more circular in shape.

Superfamily PLEUROTOMARIACEA Swainson, 1840

Family PHANEROTREMATIDAE Knight, 1956

Genus Phanerotrema Fischer, 1885

Type Species: Pleurotomaria labrosa Hall, 1860; Lower Devonian; Carlisle, New York, United States of America.

Phanerotrema australis Etheridge, 1891
(Pl. 1, figs. 11, 12. Pl. 2, figs. 3, 10, 12)

1891 *Phanerotrema australis* Etheridge, p. 128, pl. 19, figs. 4-5.

1913 *Phanerotrema australis* Etheridge; Chapman, p. 227.

1916 *Phanerotrema australis* Etheridge; Chapman, p. 83, pl. 3, fig. 25.

Diagnosis: Typical form of genus with thick, short, straight columellar lip, well-developed parietal inductura and simple rectangular sculpture pattern arising from the intersection of the collabral growth lines and spiral cords.

Description: Large, turbiniform gastropod with few whorls; whorl profile sub-angular, gently arched above and below the selenizone at the angular periphery; periphery high above midwhorl; sutures deeply impressed to sub-canaliculate; body whorl greatly expanded; umbilicus absent; columellar lip thickened, continuous with the thick extensive parietal inductura; outer lip thin with a broad sinus that forms a shallow slit at the periphery which gives rise to the selenizone; from the upper suture to the selenizone outer lip very gently prosocline; below the selenizone the outer lip is gently prosocline; gently concave selenizone moderately wide, and bordered by two threads; fine collabral growth lines and infrequent growth rugae, cancellated by two orders of fine spiral cords to form a rectangular pattern over the entire whorl surface, occasional specimens have a retroussé intersection.

PLATE 2

Fig. 1 —*Michelia brazieri* (Etheridge), F.1145, holotype, XI (approx.).

Fig. 2 —*Gyrodoma etheridgei* (Cresswell), F.2542, hypotype, XI (approx.).

Fig. 3 —*Phanerotrema australis* Etheridge, P.41706, hypotype, X 2/3.

Fig. 4 —*Siluriphorus antiquus* (Cresswell), P918, hypotype, XI. Oblique basal view.

Fig. 5 —*Scalaetrochus lindströmi* Etheridge, P39279, hypotype, X 1½ (approx.). Basal view showing prominent peripheral frill.

Fig. 6 —*Siluriphorus antiquus* (Cresswell), P917, holotype, XI. Apical view.

Fig. 7 —*Oriostoma rotundimuratus* sp. nov., P1089, holotype, Apical view.

Fig. 8 —*Loxonema australis* (Chapman), P12851, holotype, X 1½.

Fig. 9 —*Gyrodoma etheridgei* (Cresswell), P10187, holotype, X 1.

Fig. 10—*Phanerotrema australis* Etheridge, F.39308, syntype, X 2/3.

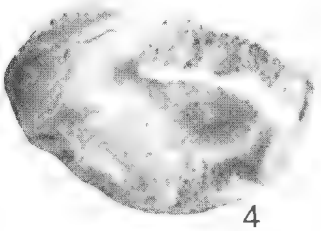
Fig. 11—*Straparollus* (*Euomphalus*) *northi* (Etheridge), F.1321a, holotype, X 2/3. Apical view.

Fig. 12—*Phanerotrema australis* Etheridge, F.39308, syntype, X 2/3.

1

2

3



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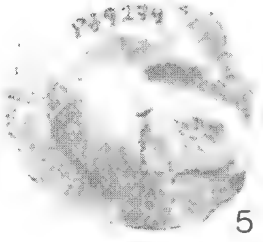

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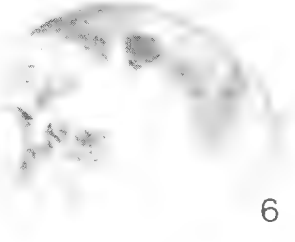

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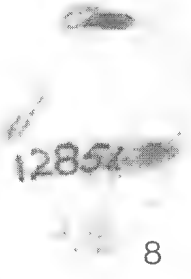

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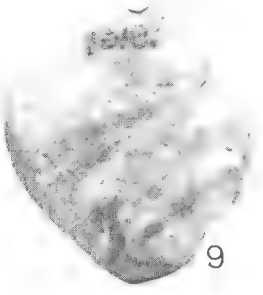

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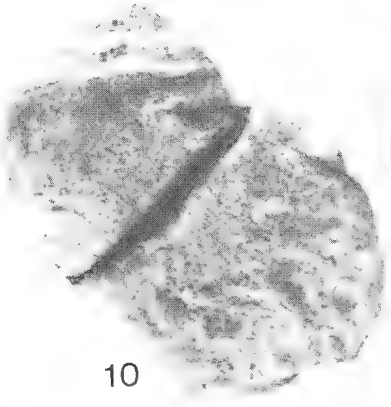

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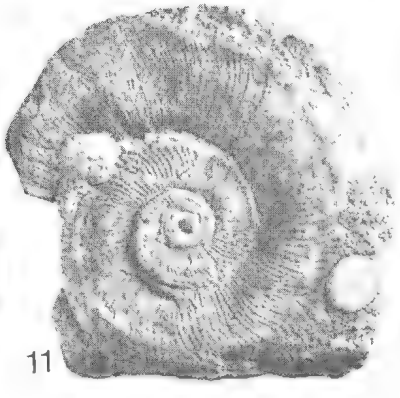

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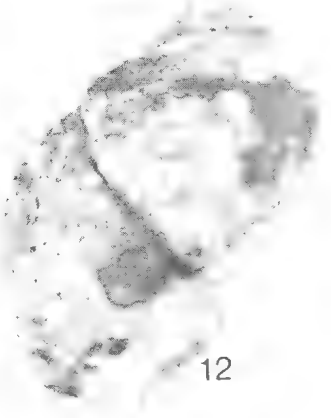


12

Dimensions:

	Ht	Wt	Hap	Wap	Wh	Clu	Cll
F.1332	24	21	—	—	4	14	16+
F.39308	82	73	—	—	2+	—	—
P384	63*	47	—	—	3+	29	31
P12841	93	78	—	—	4	28*	28*

Location of Types: Australian Museum. Syntypes, F.1332 and F.39308. National Museum of Victoria. Hypotypes, P12841, presented by Dr E. Brooke Nicholls and P41706, A. W. Cresswell Coll.

Material: Two syntypes, 2 hypotypes and 12 other specimens.

Discussion: P. Australis differs from the type species in having a straighter, more thickened and longer columellar lip. The type species' columellar lip is markedly curved. The parietal inductura on the form from Lilydale is also thicker than that of the type species. The intersection of the collabral growth lines and spiral sculptural elements in the type species is retroussé, whereas that of the Lilydale form is generally considerably simpler.

Family GOSSELETINIDAE Wenz, 1938

Genus Stenoloron Oehlert, 1888

Type Species: Pleurotomaria viennayi Oehlert, 1888; Lower Devonian; Saint-Roch (La Baconnier), département de la Mayenne, France.

Discussion: The presence at Lilydale of a member of this genus extends the known distribution as it was previously confined to Europe and North America.

Stenoloron subaequilatera (Chapman), 1916
(Pl. 1, fig. 14)

1916 *Mourlonia subaequilatera* Chapman, p. 83, pl. 3, figs. 18-19.

Diagnosis: Typical form of genus with a selenizone bordered by two cords close to mid-whorl periphery and finely developed spiral elements of sculpture.

Description: Medium rotelliform, umbilicate gastropod; whorl profile well rounded, convex; moderately impressed sutures; base rounded; aperture known only in part; outer lip with a moderately deep and angular sinus that forms a slit which gives rise to a narrow selenizone; selenizone located about one-third of the way between the mid-whorl periphery and upper suture; between the upper suture and the selenizone the outer lip is prosocline with a moderate obliquity; below the selenizone it is prosocyrt, passing forwards for a short distance before rounding gently and passing nearly radially across the base; inner lip not known; selenizone depressed and bordered by two moderately developed cords; collabral lines strongly developed; very subdued elements of spiral sculpture.

Dimensions:

	Ht	Wt	Hap	Wap	Wh	Sw
P925	16	22	—	—	5	0·4
P37643	56	61	—	—	6	0·8

Location of Types: National Museum of Victoria. Holotype, P925, A. W. Cresswell Coll. Hypotype, P37643.

Material: Holotype, hypotype and 2 other specimens.

Discussion: S. subaequilatera is represented by only a few specimens, none of which is complete. However, it is possible to distinguish it from the type species as known on the basis of Oehlert's original figures and description. The type species' selenizone is located about mid-way between the periphery and upper suture whereas that of the Lilydale form is considerably closer to the periphery. The form from Lilydale also possesses two cords bordering the selenizone and fine spiral elements of sculpture. As figured by Oehlert (1888, pl. 9, figs. 2 and 2a) it is quite possible that the cords are present although not mentioned in the description. However, there is no suggestion in Oehlert's figures of the presence of fine spiral elements of sculpture.

Superfamily ORIOSTOMATACEA Wenz, 1938

Family ORIOSTOMATIDAE Wenz, 1938

Genus Oriostoma Munier-Chalmas, 1876

Type Species: Oriostoma barrandei Munier-Chalmas, 1876; Lower Devonian; Bois Roux quarry at Gahard, near Rennes, France.

Oriostoma rotundimuratus sp. nov.
(Pl. 2, fig. 7)

1916 *Omphalotrochus globosum* (Schlotheim); Chapman, p. 92, pl. 4, figs. 35-36.

Diagnosis: Small form of genus very similar

to the type species but with stronger sculpture and more subdued collabral lines.

Description: Small, low spired, turbiniform gastropod with a few whorls in slight contact; outer whorl frequently disjunct; whorls increase rapidly in size, body whorl large; whorl profile rounded, arching upwards from the upper suture to the sub-rounded shoulder, then arching more gently to the lower slightly less rounded basal angulation surrounding the umbilicus, finally passing in a gentle convex arch to the umbilicus; sutures deep; umbilicate; columellar lip thin; parietal lip thin; outer lip thick, weakly prosocline; without sinus or slit; retroussé at the shoulder, and at each of the elements of spiral sculpture; sculpture composed of a number of strong spiral elements of at least two orders; collabral growth lines fine, slightly foliaceous and retroussé over each of the spiral sculptural elements.

Dimensions:

	Ht	Wt	Hap	Wap	Wh
P1089	7	12	—	—	3
P12850	7	—	—	—	3
P37644	5	7	—	—	3

Location of Types: National Museum of Victoria. Holotype, P1089; hypotype, P1088. A. W. Cresswell Coll.

Material: Holotype, hypotype and 7 other specimens.

Discussion: Comparison of *O. rotundimuratus* with the type species as redescribed by Knight (1941, p. 219) reveals few differences. The form from Lilydale has a more rounded whorl profile particularly in the region of the shoulder. While the collabral lines of the type species are more prominent, the spiral elements are weaker. The type species also possesses a more arcuate columellar lip and is slightly larger.

Chapman (1916, p. 93) considered this species to be *Trochilites globosus* Schlotheim (1820, p. 162). Comparison of the Lilydale form with this species is rather difficult, for Schlotheim's description is brief and he provided no figures. However, Lindström (1884, p. 162) studied the original specimen from Gotland upon which Schlotheim based his description. He synonymized *Euomphalus funatus* Sowerby (1823, p. 71) with it.

Comparison of the Lilydale form with illustrations of *E. funatus* indicates considerable differences between the two. The latter is more tightly coiled and has a thickened arcuate columellar lip. It also possesses fewer but more strongly developed spiral cords. The Lilydale form has less prominent collabral growth lines, but these are retroussé over the spiral elements, a feature apparently lacking in *E. funatus*. The sutures of *O. rotundimuratus* are also deeper.

Comparison of *O. rotundimuratus* with *Omphalotrochus globosum* (Schlotheim) as redescribed by Lindström (1884, p. 160) reveals numerous differences. The former is considerably lower spired with deeper sutures and wider umbilicus. The form from Lilydale possesses a straighter columellar lip and less rounded outer whorl profile. It also has less numerous and weaker spiral sculptural elements; nor do these elements exhibit a serrated to nodose appearance as in *O. globosum*. The Gotland form also lacks the retroussé intersection of the spiral and collabral elements as in *O. rotundimuratus*.

Superfamily	NERITACEA Rafinesque, 1815
Family	NERITOPSIDAE Gray, 1847
Genus	Naticopsis McCoy, 1844
Subgenus	Naticopsis (Naticopsis) McCoy, 1844

Type Species: Naticopsis phillipsi McCoy, 1844; Lower Carboniferous; Kilcommock, Longford, Ireland.

Range: Lower Devonian to Triassic. The presence of a species of this subgenus at Lilydale extends the lower limit of its range from the Middle Devonian to the Lower Devonian.

Naticopsis (Naticopsis) lilydalensis
Cresswell, 1893

(Pl. 1, fig. 9, 10)

1893 *Naticopsis lilydalensis* Cresswell, p. 44, pl. 9, fig. 7.
1913 *Craspedostoma lilydalensis* (Cresswell); Chapman, p. 227.
1916 *Craspedostoma lilydalensis* (Cresswell); Chapman, p. 95, pl. 4, fig. 37.

Diagnosis: Form of genus with slight spire, rounded to only slightly extended base, dis-

tinctly auriform aperture, outer lip basal region thickened and excavated; slightly arcuate to straight, thick columellar lip.

Description: Medium, low spired, naticiform gastropod; whorl profile rounded with upper surface slightly flattened; shallow adpressed sutures; base rounded to slightly extended; without umbilicus; aperture auriform, outer lip slightly, irregularly, prosocline; moderately thin on upper and outer surfaces but thickens considerably on lower surface towards junction with the columellar lip, thickened region excavated; columellar lip thick, straight to slightly arcuate; parietal inductura variably developed, generally moderately thick; collabral lines fine and closely spaced, occasionally irregular; infrequently more prominent lines developed; no other sculpture.

Dimensions:

	Ht	Wt	Hap	Wap	Wh
P948	19	—	—	—	4
P949	—	22·6	—	—	—
P37740	30	29	20	16	4

Location of Types: National Museum of Victoria. Holotype, P948; Hypotypes P951 and P37740. A. W. Cresswell Coll.

Material: Holotype, 2 hypotypes and 10 other specimens.

Discussion: Absence of the apertural region on the holotype has resulted in some confusion as to which genus this species should be assigned. Chapman (1913, p. 227) ascribed this species to the genus *Craspedostoma* without reason. Subsequently in 1916, he noted (p. 95) that the base had an umbilicus and that 'in a supplementary specimen, a part of the columellar area of the everted lip is preserved, which shows relationship to the above genus'. The hypotype P951 was considered by Chapman to possess an umbilicus. This specimen is in fact an internal mould, the umbilicus being the space that would have been occupied by the columella. No specimen has been found suggesting the presence of an 'everted lip'. Chapman also mentioned the presence of an obscure cancellated sculpture, consisting of flattened spiral and collabral ribs. Again no evidence for the presence of spiral elements has been found.

Comparison of *N. (N.) lilydalensis* with the type species reveals that it is slightly higher spired but has a less elongate last whorl. The form from Lilydale also has a more auriform aperture with a straighter columellar lip. The lower area of the outer lip is also considerably thicker. However, the parietal inductura of the type species is thicker.

Superfamily MURCHISONIACEA Koken, 1896
Family MURCHISONIIDAE Koken, 1896
Genus Murchisonia D'Archiac and De Verneuil, 1841
Subgenus Murchisonia (Murchisonia) D'Archiac & De Verneuil, 1841.

Type Species: Muricites turbinatus Schlotheim, 1820; Middle Devonian; *Stringocephalus* limestone, near Bladbach im Bergischen, Germany.

Murchisonia (Murchisonia) pritchardi (Etheridge), 1898
(Pl. 3, fig. 11, 12, 13, 14)

1898 *Goniostropha pritchardi* Etheridge, p. 71, pl. 15, figs. 1-4.
1913 *Murchisonia* (*Goniostropha*) *pritchardi* Etheridge; Chapman, p. 227.
1916 *Goniostropha pritchardi* Etheridge; Chapman, p. 88, pl. 4, fig. 29.
1916 *Cyrtostropha lilydalensis* Chapman, p. 87, pl. 4, figs. 26-28.

Diagnosis: Typical form of subgenus but possessing spiral sculpture above and below the selenizone.

Description: Medium, high spired, numerous whorled gastropod with a selenizone between two prominent cords at the angular periphery; the whorl face is flat to slightly concave both above and below the selenizone; sutures moderately deep; base rounded; lacking umbilicus; columellar lip thin, arcuate and reflexed; junction of columellar and other lip not known; parietal inductura thin; outer lip with angular sinus that forms a slit at the periphery which generates the selenizone; from the upper suture to the selenizone the outer lip passes posteriorly with a moderate obliquity; below the selenizone it passes forwards to the base less strongly; selenizone concave; collabral lines fine and weakly developed; sculpture consists of a number of spiral cords above and below the selenizone; cords more numerous below the

selenizone than above it; none of the spiral cords are as strong as those bordering the selenizone.

Dimensions:

	Ht	Wt	Hap	Wap	Wh	Clu	Cll
F.4112	20·1	9·4	—	—	7	3	8+
F.4112	22·5	9·6	5·6	4·7	7	3	—
P935	12·9	7·7	4·1	3·6	4	3	—
P936	16·5	9·5	—	—	7	3	10
P941	18·0	7·5	5·6	4·1+	6+	—	—
P944	31·2	—	—	—	8+	—	—
P946	23·0	9·5	5·4	4·0	8	—	—

Location of Types: 1. *Goniostropha pritchardi,* Australian Museum. Syntypes F.4112. Of these 5 specimens, one is that figured by Etheridge, as figure 1, plate 15, another is that illustrated as figures 2 and 3, plate 15. The former of these two specimens is the most complete and is here designated the lectotype. National Museum of Victoria. Hypotypes, P935-940. A. W. Cresswell Coll.

2. *Cyrtostropha lilydalensis,* National Museum of Victoria. Holotype, P944. Paratype, P946. Hypotypes, P941-3, P945, P947.

Material: Lectotype, 4 paralectotypes, 13 hypotypes and 48 other specimens.

Discussion: Chapman (1916, p.88) distinguished *C. lilydalensis* from *G. pritchardi* on the basis of the former's shorter habit, more angulate whorls and deeper selenizone. However, these features vary independently of each other and such variation as does exist is considered to represent variation within a population only.

Chapman (1916, p. 88) suggested that the specimen of *Murchisonia* sp. mentioned by Etheridge (1891, p.129) might be *C. lilydalensis.* Re-examination of this specimen indicates that it is not. Rather it is a poorly preserved and crushed fragment of what appears to have been a moderately large specimen of *Michelia brazieri* (Etheridge).

M. (M.) pritchardi differs from the type species noticeably in possessing elements of spiral sculpture above and below the selenizone. The type species has a slightly more angular periphery and its growth lines above the selenizone pass backwards more obliquely. The Lilydale form has a slightly higher peripheral selenizone.

Genus **Michelia Roemer,** 1852

Type Species: Michelia cylindrica Roemer, 1854; Devonian; Bockswiese, near Clausthal, Germany.

Discussion: A new Palaeozoic subgenus of the Tertiary genus *Niso* (Risso) was erected by Etheridge (1890, p. 62). He considered that ultimately it would 'reveal an organization differing from *Niso* in which case I would propose for it the name *Vetotuba*'.

Although Etheridge (1890, p. 63) mentioned that *Niso darwini* de Koninck (1876, p. 127) from Yass had an umbilicus similar to *N. (Vetotuba) brazieri,* no reference to *N. darwini* was made in the generic description and discussion. Thus Knight (1941, p. 382) considered *Vetotuba brazieri* to be the type species.

Knight (1944, p. 459) synonymized *Vetotuba* with *Coelocaulus* (Oehlert). This latter genus was in turn synonymized by Knight *et al.* (1960, p. I292) with *Michelia,* as was *Vetotuba* itself.

Michelia brazieri (Etheridge), 1890

(Pl. 1, fig. 3, 5, Pl. 2, fig. 1)

1890 *Niso (Vetotuba) brazieri* Etheridge, p. 62, pl. 8, figs. 4-5, pl. 9, figs. 2-3.

PLATE 3

Fig. 1—*Straparollus (Euomphalus) northi* (Etheridge). P1115, hypotype, X 1½. Exterior of operculum.

Fig. 2 —*Straparollus (Euomphalus) northi* (Etheridge), P28719, hypotype, X 1½. Basal view.

Fig. 3. —*Bellerophon (Bellerophon) cresswelli* Etheridge, P1087, hypotype, X 3.

Figs. 4-6—*Bellerophon (Bellerophon) cresswelli* Etheridge, F.1327, holotype, X 1 1/3 (approx).

Fig. 7—*Straparollus (Euomphalus) northi* (Etheridge, P28499, hypotype, X 2/3. Section showing transverse partitions developed in early whorls.

Fig. 8 —*Straparollus (Euomphalus) northi* (Etheridge), F.1139e, paratype, X 1 (approx.).

Fig. 9 —*Bellerophon (Bellerophon) cresswelli* Etheridge, P34938, hypotype, X 3.

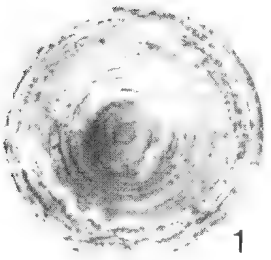
Fig. 10—*Gyrodoma etheridgei* (Cresswell), P38504, hypotype, X 4/5.

Fig. 11—*Murchisonia (Murchisonia) pritchardi* (Etheridge), F.4112b, paralectotype, X 2½.

Fig. 12—*Murchisonia (Murchisonia) pritchardi* (Etheridge), F.4112a, lectotype, X 2½.

Fig. 13—*Murchisonia (Murchisonia) pritchardi* (Etheridge), F.4112b, paralectotype, X 2½.

Fig. 14—*Murchisonia (Murchisonia) pritchardi* (Etheridge), P946, hypotype, X2.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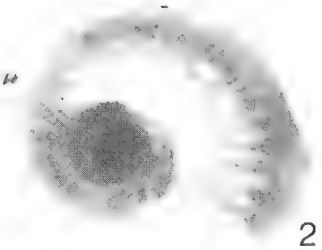
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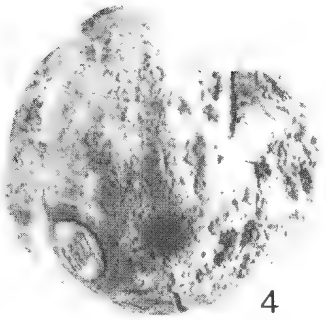
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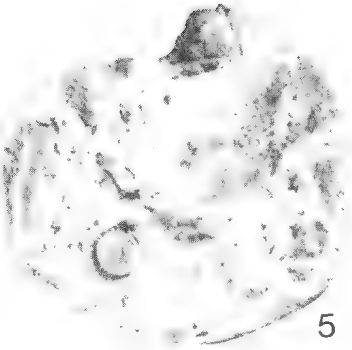
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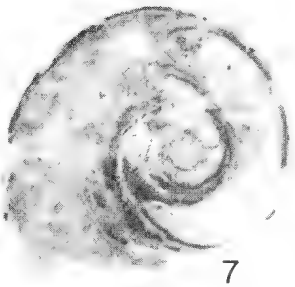
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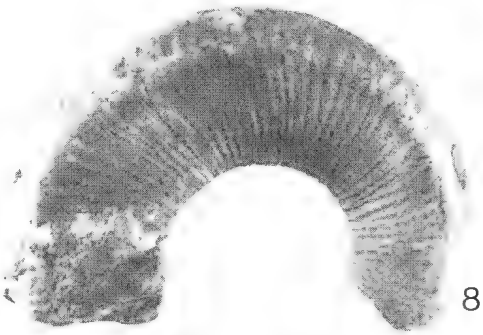
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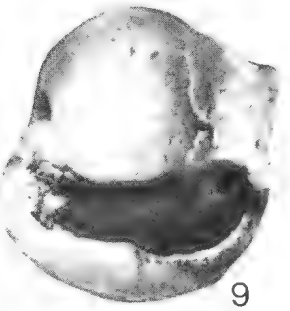
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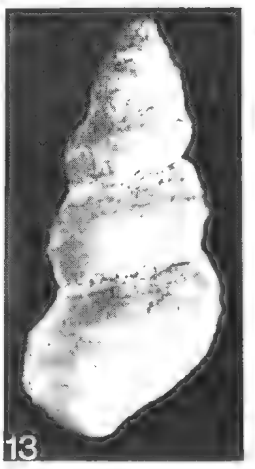
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14

1894 *Niso* (*Vetotuba*) *brazieri* Etheridge; Cresswell, p. 158.
1913 *Vetotuba brazieri* Etheridge; Chapman, p. 227 (in part).
1916 *Coelocaulus brazieri* (Etheridge); Chapman, p. 86, pl. 3, figs. 20-22.
1916 *Coelocaulus apicalis* Chapman, p. 87, pl. 3, figs. 23-24.
1941 *Vetotuba brazieri* Etheridge; Knight, p. 382, pl. 46, figs. 3a-c.

Diagnosis: Medium to large, narrowly umbilicate, cyrtoconoid gastropod, with pseudoselenizone.

Description: Medium to large, high spired, cyrtoconoid gastropod; numerous whorls; whorl profile gently convex to nearly flat; sutures shallow, impressed; base flatly rounded with sub-rounded periphery, narrowly umbilicate; columellar lip straight otherwise inner lip unknown; outer lip unknown except that it gives rise to a pseudoselenizone that is bordered by two ridges; sculpture known only in part; fine collabral lines present on the whorl base, umbilicus and lower region of the outer whorl surface; the collabral lines swing backwards moderately from the umbilicus and continue across the base and onto the lower area of the outer whorl surface, where they continue backwards a short distance; moderately thin shell; earlier whorls greatly thickened by internal secondary deposits.

Dimensions: All specimens are incomplete.

	Ht	Wt	Wh
F.1145	42	22	10
F.1240	55	—	—
P1057	43	23+	—
P1058	41	17	12
P12842	52	20+	—
P12843	32	19+	—
P37755	53	20	10

Location of Types: 1. *Vetotuba brazieri.* Australian Museum. Holotype, F.1145 (designated by Knight (1941, p.382)). Paratype, F. 1240a. National Museum of Victoria. Hypotypes, P1057, A. W. Cresswell Coll. P12842, J. S. Green Coll. P12843, G. B. Pritchard Coll.

2. *Coelocaulus apicalis,* National Museum of Victoria. Holotype, P1058. Paratype, P1059. A. W. Cresswell Coll.

Material: Holotype, 1 paratype, 6 hypotypes and 52 other specimens. Most of the specimens lack their apical region.

Discussion: Chapman (1916, p. 86) described the presence of a 'slit band below median line, feebly concave bounded by threads above and below'. He considered that P12843 exhibited the slit band. Re-examination of this specimen suggests that the irregular spiral grooves are the result of weathering. However, both P1060 and P37757 quite clearly possess a pseudoselenizone. This feature is only found on specimens preserved in the unweathered limestone. It is not normally found on specimens that have weathered free.

Chapman (1916, p. 87) erected a new species *C. apicalis* and distinguished it from *V. brazieri* on the basis of its smaller size, smaller spiral angle, more numerous whorls, particularly in the apical region, and more regularly cylindrical umbilicus. Variation in these characters in the material from Lilydale is insufficient to justify the erection of a new species and is no more than that expected in a single population.

Comparison was also made between *V. brazieri* and *Niso darwini* by Chapman (1916, p. 87). The form from Yass was distinguished principally by its smaller size and the more slender apical region. Etheridge also noted that *N. darwini* is smaller than the Lilydale form. Comparison of the two forms is limited by the nature of preservation of the Lilydale specimens. However, *M. brazieri* is generally of a greater size, particularly length, than the Yass form. *M. darwini* is also more slender in the apical region and has a more angular basal periphery.

M. brazieri as it is presently known differs principally from the type species in being cyrtoconoid in shape. Further comparison between the two is limited because of the relatively poor preservation of both the type species and the Lilydale species. One specimen P40619 is cryptomphalous, the umbilical region on the base being covered by a swollen callus deposit. This feature has only been observed in the one specimen.

Chapman (1907, p. 73) reported *M. brazieri* from the limestones of Marble Creek, Thomson River, Victoria. However, this specimen and material collected more recently

by Talent & Philip (1956, p. 62) is too poorly preserved for specific identification.

Michelia darwini (de Koninck), 1876
(Pl. 1. fig. 1, 2)

1876 *Niso darwinii* de Koninck, p. 127, pl. 4, figs. 11, 11a-c.
1898 *Vetotuba darwinii* (de Koninck); Dunn, p. 101. English translation of above.
1916 *Coelocaulus darwinii* (de Koninck); Chapman, p. 86.
1941 *Niso darwinii* de Koninck; Knight, p. 382.

Diagnosis: Small to medium, narrowly umbilicate cyrtoconoid gastropod.

Description: Small to medium, high spired, cyrtoconoid gastropod; numerous whorls; whorl profile gently convex to nearly flat; sutures shallow, impressed; base gently rounded with angular periphery, narrowly umbilicate; aperture subrhomboidal; columellar lip straight and thin, outer lip thin, straight from the upper suture and passing backwards to the basal edge very gently; sculpture unknown; moderately thin shell.

Dimensions: All material broken.

	Ht	Wt	Wh	Hap	Wap
ANU 36851	21·0	11·7	18	—	—
ANU 36852	31·5	13·2	17	—	—
ANU 36853	35·5	18·6	9	6·3	7·5
P12699	9·6	4·4	7	—	—
P12700	17·4	5·7	13	—	—
P12701	13·4	7·6	6	—	—

Location of Types: 1. *Niso darwini,* the specimens figured by de Koninck were destroyed by fire when the Garden Palace in Sydney was burnt on September 22nd, 1882.

2. *Michelia darwini,* Geology Department, Australian National University. Hypotypes, ANU 36852 and ANU 36853.

Type Locality: 1. *Niso darwini,* a black compact limestone in the Yass District.

2. *Michelia darwini;* Chatterton's (1973, p. 140) locality B, in the lower half of the '*Receptaculites*' limestone about 400 m east-southeast of the homestead on Bloomfield Property, Parish of Waroo, near Yass.

Stratigraphic Range: The '*Receptaculites*' Limestone is considered by Strusz (1972) to be Emsian.

Material: hypotypes and 23 other specimens.

Discussion: De Koninck (1876, p. 127) gave the location of his specimens as a black limestone in the Yass District. Etheridge (1890, p. 63) subsequently gave the location of de Koninck's specimens as the Upper Silurian, probably Wenlockian beds near Yass. Specimens from the Shearsby Collection in the National Museum of Victoria were collected from Portion 208, Parish of Waroo, N.S.W. Specimens from the Geology Department, Australian National University are from the localities B and M of Chatterton (1973, p.140). Both these localities are separated from the Upper Silurian sediments at Yass by a major geological structure.

The absence of a pseudoselenizone in *M. darwini* is another distinguishing feature between the two species. However, the limited preservation of this feature in the Lilydale material suggests its absence at Yass may be due to the nature of preservation.

Family PLETHOSPIRIDAE Wenz, 1938
Genus Gyrodoma Etheridge, 1898
Type Species: Eunema etheridgei Cresswell, 1893; Lower Devonian; Lilydale Limestone, Lilydale.

LOCATION OF TYPES
TYPE LOCALITY

Gyrodoma etheridgei (Cresswell), 1893
(Pl. 2, fig. 2, 9. Pl. 3, fig. 10)

1893 *Eunema etheridgei* Cresswell, p. 42, pl. 8, fig. 2.
1898 *Gyrodoma etheridgei* (Cresswell); Etheridge, p. 72, pl. 16, fig. 1.
1913 *Gyrodoma etheridgei* (Cresswell); Chapman, p. 227.
1941 *Gyrodoma etheridgei* (Cresswell); Knight, p. 138, pl. 4, figs. 1a-c.
1960 ? *Gyrodoma etheridgei* (Cresswell); Knight *et al.*, p.I296, fig. 192, 2.

Diagnosis: Large, high-spired gastropod with rounded whorls and deep sutures; selenizone broad, flat; sculpture, numerous spiral threads; typically threads also on selenizone.

Description: Large, high spired gastropod; whorl profile well rounded with deeply impressed sutures; peripheral selenizone at mid-whorl; minutely umbilicate; inner lip concave; columellar lip thickened and reflexed extends as inductura to envelope the umbilicus; parietal inductura thin and extensively developed; outer lip not known in detail, no growth lines

known; outer lip gives rise to a broad, flat, sculptured selenizone, bounded by threads slightly more prominent than those constituting the remaining whorl sculpture; the selenizone in the larger whorls generally has a single fine median spiral thread dividing it into two equal parts; the selenizone in the earlier whorls may have up to three threads so dividing it; sculpture composed of numerous fine spiral threads of two or more orders above and below the selenizone; more threads below the selenizone than above it; threads continue into the umbilicus.

Dimensions:

	Ht	Wt	Hap	Wap	Wh
P10187	29+	35+	—	—	—
P38503	62	31	—	—	5+
P38504	51	25	—	—	4+
F.2542	62	29	—	—	5+

Location of Types: National Museum of Victoria. Holotype, P10187. Presented by the Rev. A. W. Cresswell to the National Museum of Victoria on September 9, 1908. Hypotype P38504. Australian Museum. Hypotype, F.25 42.

Material: Holotype, 2 hypotypes and 24 other specimens.

Discussion: As figured by Cresswell the holotype has vertical growth lines on the divided selenizone. However, on examination of this specimen, no suggestion of their presence was found. Etheridge noted that while the holotype has a divided selenizone, hypotype F.2542 is without. Typically the selenizone has one or more threads developed on it.

Knight (1941, p. 138) designated as the holotype the left hand illustration in fig. 2, Pl. 8 of Cresswell (1893). However, it is considered both illustrations are of the same specimen. This is certainly true for the other specimens on the plate *Tremanotus pritchardi* and *Siluriphorus antiquus* which are similarly figured. Comparison of the holotype with the right-hand illustration suggests that the smaller whorl of the holotype has been broken subsequently. Supporting this is the presence of a fresh area of matrix and shell on the upper surface of the holotype.

Superfamily PSEUDOPHORACEA S. A. Miller, 1889

Family PSEUDOPHORIDAE S. A. Miller, 1889

Genus Scalaetrochus Etheridge, 1890

Type Species: Trochus (Scalaetrochus) lindströmi Etheridge, 1890; Lower Devonian; Lilydale Limestone, Lilydale.

Scalaetrochus lindströmi Etheridge, 1890

(Pl. 1, fig. 13, 15, 16, 18. Pl. 2, fig. 5)

1890 *Trochus (Scalaetrochus) lindströmi* Etheridge, p. 66, pl. 8, figs. 1-2.
1913 *Trochus (Scalaetrochus) lindströemi* Etheridge, Chapman, p. 228.
1916 *Scalaetrochus lindstroemi* Etheridge; Chapman, p. 94.
1941 *Scalaetrochus lindströmi* Etheridge; Knight, p. 306, pl. 59, figs. 3a-d.
1959 *Scalaetrochus lindströmi* Etheridge; Philip and Talent, p. 53, pl. 8, figs. 3-8.
1960 *Scalaetrochus lindströemi* Etheridge; Knight *et al.*, p. 1298, fig. 195, 1.

Diagnosis: Large trochiform low whorled gastropod with mildly concave cryptomphalous base and narrow peripheral frill; callus deposit beginning in aperture and filling peripheral angle; deposit variably developed in umbilicus, collabral lines moderately prosocline on outer whorl surfaces.

Description: Large trochiform cryptomphalous gastropod with mildly concave base; irregular sutures flush to slightly protruding; whorl profile gently to moderately concave; periphery angular, forming narrow frill; columellar lip thickened and strongly oblique outwards; parietal inductura thin or wanting; thickened outer lip moderately prosocline from the upper suture to the basal periphery, it continues obliquely across the base to the columellar lip; the columellar and outer lips on the base are strongly concave; a callus is variably developed in the umbilicus, ranging from near absence in the umbilicus to complete infilling of the umbilicus; umbilical callus continuous with the callus which occupies the peripheral angle; this material is deposited anterior to the aperture; collabral, growth lines, fine to slightly foliaceous on the outer whorl surface; collabral lines on the base are fine and when the umbilicus is open continue into it; occasional rugae occur on the base.

Dimensions:

	Ht	Wt	Hap	Wap	Wh
F.1137	47	72	18	36	5
P294	40	64	—	25+	6
P921	—	60	—	—	—
P16024	43	58	—	—	6
P38505	39	64	—	—	5
P38506	36+	64	15	30	5

Location of Types: Australian Museum. Holotype, F.1137. National Museum of Victoria. Hypotypes, P38505 and P39279. E. D. Gill Coll.

Material: Holotype, 2 hypotypes and 37 other specimens.

Discussion: As originally described by Etheridge, *S. lindströmi* was without an umbilicus. Philip & Talent (1959, p. 53) indicated that it is cryptomphalous. However, the degree of development of the callus is more variable than that intimated by Chapman (1916, p. 93) or stated by Philip and Talent.

Specimens have frequently been crushed, the base suffering the greatest distortion and damage. This occurs generally where the whorl is thinnest, at the inner edge of the peripheral angle thickening.

Genus Siluriphorus Cossmann, 1918

Type Species: Trochus gotlandicus Lindström, 1884; Middle Silurian; the canal near Westöös in Hall, Gotland, Sweden.

Range: Middle Silurian to Lower Devonian. The presence of a species of this genus at Lilydale extends the upper limit of its range from the Middle Silurian to Lower Devonian.

Distribution: Europe and Australia. The presence at Lilydale of a species of this genus extends the generic range to include Australia.

Discussion: Philip and Talent (1959, p. 53) synonymized *Siluriphorus* with *Scalaetrochus* Etheridge. They considered the differences in size, deflection of the outer lip and sculpture between the type species are specific rather than generic.

Close examination of the type species suggests that until there is a review of the entire family both genera are valid. *S. lindströmi* can be distinguished from *S. gotlandicus* by the callus deposit which is not only present in the umbilicus but also extends to fill the peripheral angle in advance of the aperture. The periphery of the Lilydale form is angular and extends to form a narrow frill, whereas the Gotland form is characterised by a more variable periphery. The holotype of *Siluriphorus gotlandicus* has a blunt angular periphery but in some specimens a blunt frill-like border is developed. Similarly the collabral lines on the upper whorl surface of *S. gotlandicus* are more variable, the holotype having quite coarse, strong, irregular imbricating lamellae. *S. lindströmi* has very much finer more regular, foliaceous collabral lines. These lines are also more arched and are not directed backwards as obliquely as in the Gotland form. *S. gotlandicus* is characterized by an almost flat to gently convex whorl profile between obscure shallow sutures, whereas *S. lindströmi* has more prominent irregular, flush to slightly protruding sutures and a distinctly concave whorl profile.

Siluriphorus antiquus (Cresswell), 1893
(Pl. 2, fig. 4, 6)

1893 *Stomatia antiqua* Cresswell, p. 43, pl. 8, fig. 3.
1894 gen. indet. Cresswell, p. 157.
1913 *Trochus* (*Scalaetrochus*) *antiquus* (Cresswell); Chapman, p. 228.
1916 *Scalaetrochus antiquus* (Cresswell); Chapman, p. 93.

Diagnosis: Typical form of genus with subrounded periphery and fine, regular, imbricating growth lamellae.

Description: Medium, trochiform gastropod with few low whorls and weakly impressed sutures; whorl profile gently convex to nearly flat between sutures; basal periphery subangular; base flat to slightly rounded, details of umbilicus not known but probably cryptomphalous; aperture probably avoidal; columellar lip thickened and strongly oblique outwards; parietal inductura thin; outer lip strongly oblique backwards from the upper suture to the periphery, only very weakly prosocline; obliquity maintained across the periphery onto the whorl base; numerous fine imbricate collabral lamellae on outer whorl surface; no thickening of the peripheral region.

Dimensions:

	Ht	Wt	Hap	Wap	W
P917	14+	39	—	—	2+
P916	36+	44+	—	—	3+
P918	13+	36	—	—	2+

Location of Types: National Museum of Victoria. Holotype, P917. Hypotype, P918. A. W. Cresswell Coll.
Material: Holotype, hypotype and one other specimen. All the specimens are incomplete and crushed to varying degrees.
Discussion: The limited number of specimens and their crushed state precludes a complete description of the species.

The type species exhibits considerable variation in the strength and coarseness of the growth lamellae, Lindström (1884, pl. 14, figs. 1-11). Knight (1941, p. 318) noted that the holotype is a specimen with coarse, strong imbricating lamellae. Although cryptomphalous there is also considerable variation in the form of the umbilical callus.

S. antiquus in comparison with the holotype of the type species has weaker, more regular imbricating growth lamellae on the outer whorl surface. The type species as exemplified by the holotype has a more angular periphery than the Lilydale form. None of the specimens from Lilydale possesses a bourrelet as found in some of the specimens from Gotland.

Superfamily LOXONEMATACEA Koken, 1889.

Family LOXONEMATIDAE Koken, 1889.
Genus Loxonema Phillips, 1841.
Type Species: Terebra? sinuosa J. deC. Sowerby, 1839; Middle Silurian; Garden House, near Aymestry, Shropshire, Britain.

Loxonema australis (Chapman), 1916
(Pl. 1, fig. 4, Pl. 2, fig. 8)

1916 *Loxonema sinuosa* var. *australis* Chapman, p. 96, pl. 5, fig. 39.
1949 *Loxonema australis* (Chapman); Gill, p. 111.
Diagnosis: Medium, intermediate form between *Loxonema* and *Palaeozygopleura.* As a member of the former genus it possesses a shallow sinus which deepens slightly with age and sutures of moderate depth.
Description: Medium, high spired numerous whorled gastropod with a shallow rounded sinus in the outer lip; whorl profile gently arched, periphery at mid-whorl; sutures moderately impressed; base rounded; lacking umbilicus; inner lip concave; columellar lip short, thickened and reflexed; parietal inductura thin; outer lip with a very shallow wide sinus developed slightly above mid-whorl; from the upper suture the growth lines are very steeply prosocline to the middle of the sinus, before passing more gently forwards to the edge of the base where they curve prosocyrtly to the centre; sinus deepens slightly with growth; outer lip of moderate thickness, except towards the junction with the columellar lip where thicker; collabral sculpture consisting of costae and costellae; protoconch unknown.
Dimensions:

	Ht	Wt	Hap	Wap	Wh
P12851	22	19	—	—	1
P38507	47+	19	—	—	5+
P38508	31+	14	8	12	5+

Location of Types: National Museum of Victoria. Holotype, P12851, J. S. Green Coll. Hypotype, P38508.
Material: Holotype, hypotype and 8 other specimens.
Discussion: Comparison of *L. australis* with the type species *L. sinuosa* reveals that the form from Lilydale has a distinctly shallower and wider labral sinus. It also has a coarser collabral sculpture which weakens slightly on the base and is slightly larger. There is no evidence for 'a tendency to form a faint nodose shelf near the basal part of the whorl', the only distinguishing feature between the two species noted by Chapman.

The type species of *Palaeozygopleura, P. alinae* Perner, when compared with the Lilydale form has a noticeably shallower and wider labral sinus. It also is considerably smaller and has much shallower sutures than *L. australis.* Thus the form from Lilydale occupies an intermediate position between these two genera as regards the depth of the labral sinus. Such a situation is not unexpected. Knight (1930), postulated that *Loxonema* gave rise to the Carboniferous Pseudozygopleuridae through an unknown *Pseudozygopleura*-like form that existed in the Devonian or Lower Carboniferous. This form was most probably represented by the Palaeozygopleuridae and more particularly *Palaeozygopleura.* Thein and Nitecki (1974,

p. 29) considered 'that the Palaeozygopleuridae evolved from *Loxonema* directly during the Devonian or Mississippian and gave rise to the Pseudozygopleuridae that flourished in the Pennsylvanian and Permian'.

The Mississippian form *L. knighti* Yochelson (1962, pl. 17, fig. 11) possesses in its intermediate growth a shallow wide labral sinus and moderately strong collabral sculpture comparable to the intermediate growth stage in *L. australis*. In its mature form the American species possesses the characteristically deep labral sinus of the genus. However, the labral sinus of the mature Lilydale form does not deepen as much, although it is deeper than that of the immature American form. The species are comparable in size.

Two other genera within the family Loxonematidae also possess shallow sutures, they being *Stylonema* and *Aulacostrepsis*. Both occur in the Lower Devonian. However, *Stylonema* is characterized by a very slender shell and the similar *Aulacostrepsis* also has a very small umbilicus.

Although the Lilydale form is obviously intermediate between the two genera *Loxonema* and *Palaeozygopleura* it is for the present assigned to the former genus because of its moderately deep labral sinus, which deepens slightly with growth, size, moderate sutures and the nature of the labral sinus in other genera of the family Loxonematidae.

Gill (1949, p.111) in redescribing the holotype considered that Chapman's variety was in fact a new species distinguished by the coarser nature of the sculpture and the straighter costellae. He also assigned the form from Sandy's Creek, Parish of Nungatta, Gippsland to this species noting that it is smaller and that the ornamentation is proportionally finer. However, Talent (1963, p.102) considered that the form from Sandy's Creek differs sufficiently from *L. australis* to be considered a new species, this species being distinguished by its overall size. Never exceeding 10 mm in width, it is much smaller than *L. australis*. The whorls in the form from Sandy's Creek are also proportionally higher than those of *L. australis*. This unnamed species of *Loxonema* is also found in the mudstones at Loyola.

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A NEW SPECIES OF *HEMIERGIS* (SCINCIDAE: LYGOSOMINAE) FROM VICTORIA

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Abstract

A new species of lygosomid skink (*Hemiergis millewae*) is described, from the Victorian Mallee Region.

Introduction

Field work in the Victorian Mallee since 1973, has revealed the presence of a small, pentadactyl, lygosomid skink, not previously known from this State. The species fits into the genus *Hemiergis* Wagler, 1830, as recognized by Greer (1967), but does not fit the only pentadactyl species (*H. initiale* Werner, 1910). A thorough search of the National Musuem of Victoria collections brought to light a further five specimens, which had previously been identified as *Anotis maccoyi* (Lucas and Frost).

The genus *Hemiergis* was first erected by Wagler in 1830,and has since been redefined by many authors, principally Gray (1845), Boulenger (1887), Mittleman (1952), Greer (1967), Cogger (1975) and Storr (in Press). Although Cogger and Storr provide the most recent definitions, Greer's concept of the genus is accepted here.

Gray provided the first detailed diagnosis of the genus, restricting it to skinks with transparent lower eyelids, and digits 3–3. He also considered the presence of paired frontoparietals to be diagnostic, a character which Storr has shown to be variable within the genus, even at the specific level. Mittleman restricted the genus to species having 4–4 or less digits, thus excluding Werner's 1910 pentadactyl species *H. initiale*. Greer's diagnosis accepted *H. initiale* as a true *Hemiergis*, thus expanding the genus to include pentadactyl species. Cogger's definition contradicted Greer's in that it included . . . 'ear opening usually absent, its position is usually indicated by a slight depression (a minute opening in one species)'. All other workers have agreed that the ear opening is in fact covered by scales. Cogger's move was made to allow the inclusion of *Siaphos maccoyi* Lucas and Frost into *Hemiergis*, thus making *Hemiergis* polyphyletic, as Cogger recognized when he said . . . 'the genus as recognized here is almost certainly composite, but relationships are obscure'.

Storr's definition basically agrees with that of Greer, differing in that Storr said that all species have a complete series of suboculars, whereas Greer stated that the subocular row was 'complete, except in *H. initiale*'. In addition to the above characters, Greer also separated *Hemiergis* from *Lerista* by the presence of four supraoculars as against 2–4, usually 3, paired rather than single supradigital scales on the fourth toe, and non-enlarged as against greatly enlarged nasal scales.

Genus Hemiergis Wagler, 1830

Hemiergis Wagler, 1830, *Nat. syst. amphib.*, p. 160. Type-species *Zygnis decresiensis* Fitzinger, 1826.

Diagnosis: Small elongate, short-limbed skinks. Lower eyelid movable, with a transparent disc. Digits 5–5 to 2–2, normally equal numbers on fore and hind limbs. Subdigital lamellae less than 16. Subocular row complete in all non-pentadactyl species. Ear aperture absent, ear indicated by a depression. Supradigital scales paired.

Hemiergis millewae sp. nov.

Fig. 1

Holotype: D47410, adult male in the National Museum of Victoria, collected at Millewa South bore, Vic., in 34°56′28″S: 141°4′E on 15.XI.1975 by A. J. Coventry and P. Mather.

Description: Snout-Vent (S.V.) length 43·5 mm. Length of tail (intact) 75·3 mm, 173% of S.-V. length. Total length 118·8 mm. Length of hind limb 13·0 mm, 30% of S.-V. length. Length of fourth toe 4·7 mm, 36% of hind

limb length. No supra or postnasal scales. Rostral and frontonasal in fairly broad contact. Frontal and frontonasal in narrow contact. Prefrontals large, just failing to meet: contacting the frontonasal, anterior and posterior loreals, first supraciliary and frontal. Two loreals, large and subequal. Frontoparietal entire, interparietal separate, large, almost half the size of the frontoparietal. Parietals large, barely contact along the midline. One pair of enlarged nuchals, followed by a second, single nuchal on the left hand side. Three enlarged temporals, the upper largest. Four supraoculars, the second the largest. Seven supraciliaries, seven upper ciliaries, the third to fifth largest. Nine lower ciliaries. Lower eyelid movable with an extremely large transparent palpebral disc bordered above by the lower ciliaries but otherwise surrounded by small granular scales.

Length of eye 1·6 mm, length of disc 1·1 mm, 69% of eye length. Seven upper labials, the fifth subocular and completely interrupting the subocular series, of which two are anterior to, and three posterior to the fifth upper labial. Seven lower ciliaries. Ear opening completely covered by scales, indicated by a depression. A pair of enlarged preanal scales. Limbs short, pendactyl, when adpressed, failing to meet by approximately 25% of the distance between the axilla and the groin. Subdigital lamellae dark coloured, undivided and smooth, 12 under the fourth toe. Midbody scales smooth, in 22 rows.

Colour in Life: Uniform dark olive brown dorsally, with no trace of spots, striations or lines. A burnt orange dorso-lateral stripe, approximately two scales wide, commencing above and behind the ear, and extending to the hind limbs. Lateral surfaces off-white, and ventral surfaces pale yellow. Dorsal and lateral surfaces of tail similar to mid-dorsal colour, ventral surfaces of tail off-white, with darker spots. Chin whitish, each scale bordered by dark brown.

Colour in Alcohol: Drab brown dorsally, whitish laterally, and light grey ventrally. There is almost no trace of the dorso-lateral stripe.

Paratypes: Fifteen specimens in the National Museum of Victoria as follows:

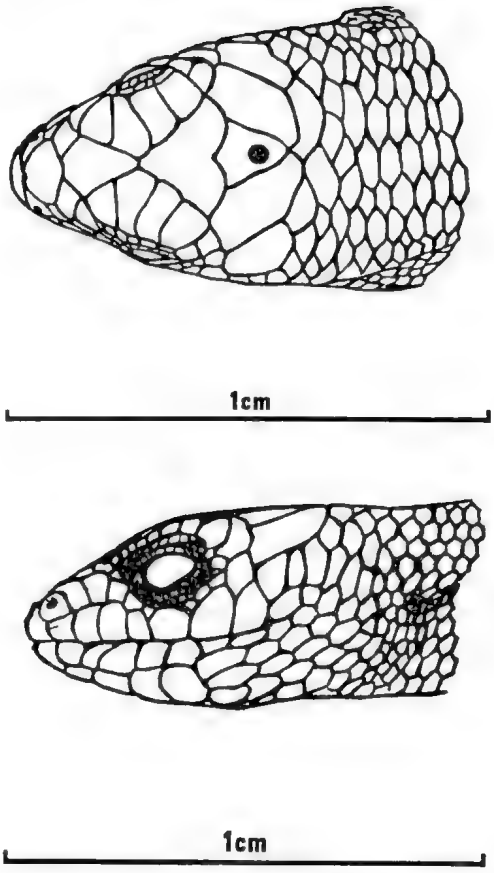

Fig. 1—Head shields of holotype of *Hemiergis millewae* D47410, dorsal and lateral views.

D33348 sex undetermined, D33349 male, 0·3 km S of Millewa South Bore, collected G. Barnes 31.8.1973; the remaining thirteen specimens, all from Millewa South Bore as follows:
D33341—2 sex undetermined, collected by G. Barnes 29.8.1973;
D38847 sex undetermined, collected A. J. Coventry 4.4.1974.
D40169 sex undetermined, collected A. J. Coventry 24.9.1974;
D47394—6 males, D47397 female, collected A. J. Coventry and P. Mather 13.11.1975;
D47398—400 females, collected A. J. Coventry and P. Mather 14.11.1975;
D47418 male, and D47419 female, collected A. J. Coventry and P. Mather 16.11.1975.

Description of Paratypes: As for holotype excepting as follows: S.-V. lengths 41·7–58·6 mm (mean 50·2); hind limb length 11·1–13·7 mm (mean 12·3); percentage of S.-V. length 23·1–28·1 (mean 24·7); length of 4th toe 4·5–5·4 mm (mean 4·8) percentage of hind limb length 35·7–42·0 (mean 39·0). Upper

ciliaries 8–10 (mean 9·1), lamellae under 4th toe 12–14 mean (12·8).

Nuchals: one pair (4 specimens), two pairs (2 specimens), two pairs plus a third on right side (1 specimen), two pairs plus a third on left side (1 specimen). D33348 has a damaged first toe on the left hind foot; D40169 has the right fore foot missing; D47395 has the second and third fingers of the right fore limb damaged; D47397 has a damaged left fore foot, the second and third fingers, which arise from a common base, being truncated to appear as a single digit; D47398 has the third toe on the right hind foot truncated; D47418 has a damaged fourth toe on the left hind limb.

Colour of all these specimens, in alcohol, similar to the holotype, excepting that in many of them, the dorso-lateral stripe is completely missing.

OTHER SPECIMENS EXAMINED

D1552–3, D1556 from Purnong, S.A., D11767–8 from Nonning, S.A., and D47409, a juvenile, same data as for holotype.

Ecology: Little is known of the ecology of this species. It resides in porcupine grass (*Triodia* sp.) in sandy soil supporting a fairly heavy cover of mallee scrub. It never appears to emerge from the *Triodia,* and was only located either by burning or the ripping out of this grass. No activity was observed at any time of the day or night, although other species of reptiles (e.g. *Ctenotus brachyonyx, Menetia greyi, Amphibolurus barbatus, Amphibolurus fordi, Delma inornata* and *Lialis burtoni*) were active during the time spent collecting the type series. Obviously *H. millewae* is a thigmotherm, dependent upon *Triodia,* which one assumes supplies its food source in the many forms of invertebrates co-habiting with it.

Key to Hemiergis millewae and other southern short limbed skinks

1. Ear opening visible, not covered by scales 2
   Ear covered by scales, indicated by a depression 3
2. Nasals enlarged, meet or almost meet behind rostral ..... *Lerista* species
   Nasals not enlarged ..... *Anotis maccoyi*
3. Digits 5–5 4
   Digits 4–4 or less .... all other known *Hemiergis*
4. Hind limb at least 20% of S.-V. length, subcaudals 12 or more ..... *H. millewae*
   Hind limb less than 20% of S.-V. length, subcaudals 11 or less ..... *H. initiale*

This species is named in recognition of the locality where the type series was collected.

TABLE 1

Showing comparative lengths of hind limbs, and lamellae under longest toe of *H. millewae* and its allies

SPECIES	N	Hind Limb % S.-V. length			Lamellae under longest toe	
		Max.	Min.	Mean	No.	Mean
H. millewae	16	29·9	21·0	25·1	12–14	12·8
H. initiale	21	18·7	13·2	16·0	7–10	8·8
H. peroni	18	23·6	17·7	20·2	10–14	10·7
H. decresiensis	24	16·5	11·1	13·8	7–8	7·0
A. maccoyi	21	19·5	15·1	17·2	8–9	8·3

Addendum

Through the courtesy of Dr. T. F. Houston of the South Australian Museum, I have been able to examine an additional 119 South Australian specimens of this species, which are under his care. These are as follows:—
R112 Purnong; R3044 A — F near Siam Station woolshed, 19.3.1950 under *Triodia;* R3069 A — Z Birthday Well, Cariewerloo Station 11.3.1950; R3855 & R10760 — 1 24 km N. Poochera 15.6.1956; R3860, R10767 — 73 & R10775 — 6 Kondoolka Turnoff, Gawler Ranges 17.6.1956; R5377 & R10762 6 Gawler Ranges March 1963; R10733 — 58 Mamblyn 29.4.1969; R11284 21 km N. E. Blanchetown 16.2.1969 in sandy soil under a spinifex bush in mallee scrub; R12490 A — Z Miccollo Hill, Siam Station 32° 32′ S.: 136° 36′ E. 20.4.1971 — ex *Triodia* Bush; R12619 8 km from Bakara 34° 4′ S.: 139° 45′ E. January 1970; R13012 A — G 13 km S Alawoona 36° 6′ S.: 140° 32′ E. 24.1.1972 — ex *Triodia* bushes; R13099 A — C near Oulnina homestead, Olary Ridge, 32° 34′ S.: 139° 53′ E. March — April 1972; R13381 Hiltaba Reservoir 32° 10′ S.: 135° 4′ E. 26.8.1972; R13704 1.5 km S. of Mulgathing Rocks 30° 7′ S.: 134° 0′ E. 23.4.1973 in Granite outcrop; R14766 10 km E., 7.5 km N. of Blanchetown 28.8.1975 low dune mallee.

Of these specimens R3069B, R11284 & R13012B each have one foetus in utero, R3069M, R13012A & D each have two foetuses in utero, and R3069X, R10736 & R107 48 are hatchlings. This confirms that the species is viviparous, having one or two young per litter, the young being born in late summer or early autumn. In these series the midbody scale rows vary from 22 — 24.

Acknowledgements

The author wishes to thank Dr G. M. Storr of the Western Australian Museum for the loan of comparative material of *Hemiergis initiale*, and for permission to quote from his unpublished manuscript. Mr P. A. Rawlinson, Latrobe University for help, encouragement and critical reading of the manuscript. Mr P. Mather assisted in both field and laboratory, and Miss L. Leatham assisted in the laboratory. Miss R. J. Plant for the drawings of head scales.

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THE ENDEMIC AUSTRALIAN LIZARD GENUS *MORETHIA* (SCINCIDAE: LYGOSOMINAE) IN SOUTHERN AUSTRALIA

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Abstract

The taxonomy and status of the five southern Australian species of *Morethia* are discussed and lectotypes are nominated to stabilize the nomenclature. Details of the species distributions are provided and the ecology, reproduction, generic relationships and phylogeny of the species are briefly mentioned.

Introduction

Boulenger (1887) carried out the first major revision of the family Scincidae in the third volume of his *Catalogue of Lizards in the British Museum (Natural History)*. In the Preface to this volume Dr A. Gunther stated: 'I feel confident that it will give a fresh impluse to the systematic study of lizards, and serve as the standard work for many years to come'. Gunther's confidence was generally well placed and Boulenger's Catalogues became the standard reference works. However, in some groups rather than give a fresh impulse to systematic studies, Boulenger's concepts caused a stagnation that lasted more than half a century. One such group was his large and clumsy genus *Lygosoma* with it's eleven subgenera, and another was the genus *Ablepharus* into which Boulenger placed all skinks with an immoveable transparent lower eyelid (the 'ablepharine' eye). These genera were long recognized to be polyphyletic, but it wasn't until Mittleman (1952) erected the subfamily Lygosominae and revised the included genera that a new stimulus was provided. Mittleman included the species Boulenger had placed in *Ablepharus* in the Lygosominae and broke up the genus. Since that time work on the higher taxa of Lygosomine skinks has made rapid progress and the species Boulenger included in the genus *Ablepharus* have been reclassified.

The Australian skinks which were included in Boulenger's definition of the genus *Ablepharus* have been dealt with in two main papers. Greer (1967) convincingly demonstrated the artificial nature of the 'ablepharine' eye taxonomically and phylogenetically when he united a group of closely related 'ablepharine' and 'non-ablepharine' skink species in the genus *Lerista*. Subsequently Fuhn (1969) separated the Australian 'ablepharine' skinks into nine groups, one of which was the genus *Morethia* Gray, 1845. Fuhn separated the genus *Morethia* on the basis of skull morphology and in doing so successfully placed a natural group of closely related species into one genus. *Morethia* is now recognized to be an endemic Australian genus which is not clearly related to any non-Australian genus (Storr 1972) and even its Australian relationships are unclear (Rawlinson 1974). The genus presently consists of six described species, two described subspecies and an undescribed 'race' (Storr 1972).

The *Morethia* species and subspecies (and therefore the genus) can be divided into two geographical and evolutionary groups: a 'northern' group centered in the arid and semi-arid tropical areas of Australia; and a 'southern' group centered in the arid and semi-arid temperate areas of Australia. The 'northern' group consists of: *M. taeniopleura taeniopleura* (Peters 1874) found in N and E Queensland, which reaches to 27½° S but is centered N of the Tropic of Capricorn 23½° S; *M. taeniopleura ruficauda* (Lucas and Frost 1895) found in N Northern Territory and N Western Australia, which reaches to 25½° S but is centered N of the Tropic of Capricorn; *M. taeniopleura exquisita* Storr 1972 found in NW Western Australia, which reaches to 25° S but is centered N of the Tropic of Capricorn; and an undescribed race of *M. taeniopleura* recorded from the N of the Northern Territory by Storr (1972). These

'northern' taxa are allopatric and appear to be mutually exclusive (Storr 1972).

The 'southern' group consists of the remaining five described species and it appears to have radiated more widely than the 'northern' group. Three of the five 'southern' species, *M. adelaidensis, M. butleri* and *M. obscura,* although reasonably widely distributed are restricted to arid and semi-arid areas S of 27½° S; the fourth species, *M. lineoocellata,* is virtually restricted to the SW coast of Western Australia but it extends above the Tropic of Capricorn to about 20½° S; the fifth species, *M. boulengeri,* is widely distributed across S Australia and it extends just above the Tropic of Capricorn to about 22½° S in S Queensland. Of the 'southern' taxa, *M. boulengeri* and *M. butleri* are allopatric and appear to be mutually exclusive as do *M. lineoocellata* and *M. obscura; M. butleri* and *M. adelaidensis* are largely allopatric but overlap in SE Western Australia; and *M. adelaidensis, M. boulengeri* and *M. obscura* overlap widely across S Australia. Thus it can be seen that the Tropic of Capricorn forms a boundary between the 'northern' and 'southern' groups of *Morethia* and it is the five 'southern' species as defined above which are dealt with in detail in this paper.

Two recent local revisions of the genus *Morethia* included the five 'southern' species. The first revision, published by Smyth (August 31, 1972) was of the South Australian species but it also included all specimens of *Morethia* in the South Australian Museum. Storr published the second revision (November 3, 1972), which was of the Western Australian species but it also included all specimens of *Morethia* in the Western Australian Museum. Unfortunately Symth's and Storr's papers contain some conflicting interpretations and neither author examined the types of *Morethia lineoocellata* (Dumeril and Bibron 1839) which was the first of the *Morethia* species described and hence the most important taxonomically. The present paper deals with the 'southern' *Morethia* species in Queensland, New South Wales and Victoria, and as the author has examined all relevant type specimens, the opportunity to correct the conflicts between Smyth's and Storr's papers is taken. Also, as the author has examined and identified all *Morethia* specimens in the Queensland Museum (QM) Brisbane, the Australian Museum (AM) Sydney, and the National Museum of Victoria (NMV) Melbourne, detailed lists of these specimens are provided under the appropriate headings below to complement the data in Smyth and Storr. As there is no *Morethia* material in the Tasmanian Museum, Hobart, or the Queen Victoria Museum, Launceston, the data in Smyth's and Storr's papers and the present paper represents a complete listing of the 'southern' *Morethia* specimens held in the Australian state museums.

Genus **Morethia** Gray, 1845

Morethia Gray, J. E., 1845, *Catalogue of lizards*: 65.
TYPE SPECIES: *Morethia anomalus* Gray, 1845, *Ibid.*: 65 = *Ablepharus lineoocellatus* Dumeril, and Bibron, 1839, *Erpetologie Generale* **5**: 817.

Remarks: Smyth (1972) incorrectly listed *Ablepharus lineoocellatus* Dumeril and Bibron 1839 as the type species of the genus. Storr (1972) listed *Morethia anomalus* Gray 1845 as the type species by monotypy and in the same paper designated *M. anomalus* as a junior subjective synonym of *A. lineoocellatus.*

Diagnosis: Small skinks (snout-vent length 17-56 mm); an 'ablepharine' eye i.e. lower eyelid an immoveable transparent disc fused to the eye surface; Frontoparietals and interparietal fused into a single large shield; parietals contact along midline; supranasal and postnasal scales present but may be fused to each other or to nasal scale; frontonasal in broad contact with the rostral; frontal much larger than the prefrontals; prefrontals rarely in contact; four supraoculars, second the largest, first and second contact the frontal, second third and fourth contact the frontoparietal-interparietal shield; one pair of nuchal scales; seven (occasionally eight) upper labial scales, the fifth largest and completely subocular; eight to ten preanal scales, central four slightly enlarged; limbs pentadactyl; digits not elongate, 14-27 lamellae under the fourth toe; body scales smooth, moderately large, 24-34 rows at midbody; external ear opening obvious.

In the descriptions of *Morethia* species and specimens below, scalation details consistent with the generic description above are not repeated.

KEY TO THE SOUTHERN AUSTRALIAN SPECIES OF *MORETHIA*

1. Subdigital lamellae acutely keeled, unicarinate to tricarinate; five or six supraciliaries ..... 2.
   Subdigital lamellae smooth or obtusely keeled; six supraciliaries ..... 3.
2. Five supraciliaries, the third, fourth and fifth largest, subequal, and penetrate deeply between the supraoculars; subdigital lamellae unicarinate or tricarinate ..... *M. adelaidensis*
   Six supraciliaries, the first the largest and the remainder forming a decreasing series, junctions of supraciliaries with supraoculars linear or slightly curved, supraciliaries do not penetrate between supraoculars; subdigital lamellae unicarinate ..... *M. butleri*
3. First and third supraciliaries largest, fourth much smaller than third, fourth, fifth and sixth successively smaller ..... *M. boulengeri*
   First supraciliary never largest, fourth not smaller than third ..... 4.
4. Third, fourth and fifth supraciliaries largest, subequal and penetrate deeply between the supraoculars, sixth much smaller than fifth; supranasal often fused to nasal ..... *M. lineoocellata*
   Fourth supraciliary largest, fourth, fifth and sixth form a rapidly decreasing series, third and fourth penetrate deeply between supraoculars; supranasal always separate from nasal ..... *M. obscura*

Morethia adelaidensis (Peters 1874)

(Fig. 1)

Ablepharus (Morethia) anomalus adelaidensis Peters, 1874, *Mber. Preuss. Akad. Wiss.*: 375-376.
Ablepharus lineoocellatus C var. *adelaidensis* Boulenger, 1887, *Catalogue of the Lizards in the British Museum (Natural History)*. **3**: 349.
Ablepharus lineoocellatus (part) Zietz, 1920, *Rec. S. Aust. Mus.* **1**: 220-221.
Morethia adelaidensis Smyth, 1972, *Rec. S. Aust. Mus.* **16**: 1-14. Figs. 1, 6.
——— Storr, 1972, *J. R. Soc. W. Aust.* **55**: 73-79. Figs. 1, 2.

Lectotype: Smyth (1972): ZMB 4733, Zoologisches Museum der Humboldt Universitat zu Berlin. Locality: Adelaide. Collector: Schomburgk. No other data.
Description: See Smyth (1972).
Remarks: The lectotype, selected by Smyth in 1971, was the largest of three syntypes under this catalogue number and the paralectotypes have now been given new numbers, ZMB 42872-73, data as for lectotype.

Smyth (1972) and Storr (1972) both commented on Peters' (1874) use of the name *Ablepharus (Morethia) anomalus adelaidensis* and neither considered Peters' description adequate. However, Smyth considered Peters' use of the name constituted a valid indication of a species, ascribed the name to him, and accordingly selected one of Peters' three syntypes from the Berlin Museum as lectotype. Storr, however, did not consider Peters, use of the name constituted a valid indication of a species so he refused to ascribe the name to Peters, but he did not formally state it was a *nomen nudum*. Boulenger (1887) had ascribed the name *adelaidensis* to Peters when redescribing the 'variety' as *Ablepharus lineoocellatus* C var. *adelaidensis*, and there is every chance he examined Peters' types for he stated in the Introduction to Volume *3* of his Catalogue 'With the object of rendering the account of the Lacertidae and Scincidae more perfect, I have devoted a month to the examination of the specimens in the Berlin Museum'. Storr regarded Boulenger as the proper authority for the name *adelaidensis* and accordingly selected a lectotype from the specimens described by Boulenger in the collection of the British Museum of Natural History in London: BM NH 64.10.27.9; Locality: South Australia; Collector: G. Krefft; no other data. Smyth had already examined the specimen which Storr subsequently designated as lectotype and identified it as *M. adelaidensis*. The present author has re-examined Storr's lectotype and confirms it is conspecific with the lectotype selected by Smyth (ZMB 4733).

Smyth's designation of the lectotype is cor-

rect and must be upheld. Storr's action would have been valid if Peters' use of the name *adelaidensis* constituted a *nomen nudum,* but Storr did not state this was the case and articles 11., 12. and 16. of the International Code for Zoological Nomenclature (1964) show Peters' use of the name constituted a valid indication of the species. It should be noted that Boulenger himself ascribed the name *adelaidensis* to Peters, so both authors were referring the name to specimens Peters had examined in the Berlin Museum and there is a great probability that Boulenger actually examined Peters' types. Smyth located these specimens and designated one as lectotype, and as Smyth's paper was published on August 31, 1972 and Storr's paper was published on November 3, 1972, Smyth's designation predates Storr's.

Diagnosis: Five supraciliaries, the third, fourth and fifth the largest, subequal, and all penetrate deeply between the supraoculars. Subdigital lamellae acutely keeled, unicarinate or tricarinate. Palmar tubercles elongate and apically rounded.

Description: Snout-vent length 17-60 mm, mean 46·1 mm. Total length adults with intact tails 104-138 mm, mean 118·8 mm. Intact tail 120-172% of snout-vent length. Supranasals present, widely separated. Postnasals present but often fused to supranasals. Prefrontals narrowly separated. Frontonasal wider than long. Frontal longer than wide. One to three ear lobules, usually hidden by projecting preauriculars. Midbody scales in 26-34 rows (usually 28 or 30), mean 29·1. Lamellae under fourth toe 16-24, mean 19·7.

Colour: Olive-grey to olive-brown dorsal surface, often tinged with red-brown. Small black spots on back which tend to form broken lines. Pale dorsolateral stripe occasionally present on trunk. Broad dark brown to black upper lateral stripe strongly speckled with lighter markings runs from head onto tail. Wavy edged interrupted white mid-lateral line runs from upper labials, through ear, above forelimb and along trunk to hindlimb, usually margined below by a speckled brown band. Ventral surface unmarked, white. Males in breeding condition develop an orange colour all around the edges of the ventral surfaces which extends onto the inside surfaces of both fore and hind limbs and is particularly prominant around the vent and anterior part of the tail.

Distribution: Arid and semi-arid-areas of SW Queensland; SW New South Wales; NW Victoria; NE to S South Australia; and SE Western Australia. (Figure 1.).

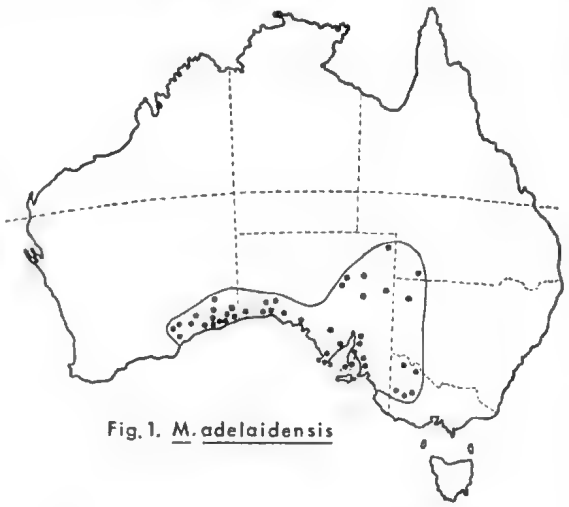

Fig. 1. M. adelaidensis

Literature Records: See lists in Smyth (1972) and Storr (1972).

Specimens Examined: Western Australia: (NMV) Western Australia, R 963; D 1013; D 1390:15 mls E of Caiguna, D 44857: *South Australia:* (AM) South Australia, 4739: Fisher, Nullabor Plain, R 7274: (NMV) Central Australia, D 1181; D 1183-4: Gawler Ranges, D 2464-5: Ooldea Well, Overland Railway, N of Fowlers Bay, D 2473: Overland Railway, between Ooldea Well and Fowlers Bay, D 2758: Overland Railway to Western Australia, D 3059; D 3109; Lake Eyre, D 3103; D 3128; D 3135: Lake Harry, Birdsville Track, D 15027: Lake Wangary, Eyre Peninsula, D 15054-7; D 15059-60: 3 km NW of Poonindie, D 15078: Tumby Bay, Eyre Peninsula D 15078-80; D 15217: 18½ km S of Maitland, Yorke Peninsula, D 15093-7: Copley, D 15847-8: Benagerie Station, D 41509, D 41525: Innamincka area, D 41606-7: *New South Wales:* (AM) Moloch, R 6445

(3 specimens): *Victoria:* (NMV) Grampians, D 1090: 16 km W of Nowingi, D 14652: 13 km S Stawell, D 15064: Kerang, D 15163: 32 km S of Kaniva, D 15174-5: 29 km N of Swan Hill, D 15177: 10 km W of Nowingi, D 18106.

Morethia boulengeri (Ogilby 1890)

(Fig. 2)

Ablepharus boulengeri Ogilby, 1890, *Rec. Aust. Mus.* **1**: 10-11.
———— Zietz, 1920, *Rec. S. Aust. Mus.* **1**: 220.
Ablepharus lineoocellatus anomalus (part), Loveridge, 1934, *Bull. Mus. Comp. Zool.* **77**: 377-378.
Morethia boulengeri Smyth, 1972. *Rec. S. Aust. Mus.* **16**: 1-14. Figs. 2, 6.
———— Storr, 1972, *J. R. Soc. W. Aust.* **55**: 73-79. Figs. 1, 2.

Lectotype: Smyth (1972): AM R 690, Australian Museum, Sydney. Locality: Brawlin, New South Wales (34° 44′ S 148° 02′ E). Collector: H. J. McCooey. No other data.
Description: See Smyth (1972).
Remarks: Smyth (1972) noted that Ogilby incorrectly recorded a separate interparietal for the type. Storr (1972) listed Cootamundra, New South Wales (10 km N of Brawlin) as the type locality, which is the locality given for the specimen in the Australian Museum Register.
Diagnosis: Six supraciliaries, the first and third the largest; the fourth much smaller than the third; and the third, fourth, fifth and sixth are successively smaller. Subdigital lamellae smooth or obtusely unicarinate. Palmar tubercles rounded.
Description: Snout-vent length 27-55 mm, mean 44·6 mm. Total length adults with intact tails 102-121 mm, mean 109 mm. Intact tail 125-177% of snout-vent length. Supranasals present, widely separated. Postnasals present but often fused to supranasals. Prefrontals separated. Frontonasal wider than long. Frontal longer than wide. Seven upper labials normally, rarely eight but the fifth always largest and entirely subocular. Two to four obtuse ear lobules (usually two). Midbody scales in 25-32 rows, mean 29·8. Lamellae under the fourth toe 15-23, mean 19·6.
Colour: Olive-grey to brown dorsal surface, dorsal scales have 2-5 (usually 3) fine diverging black lines which are often expanded and merge into black spots or streaks that are usually distributed irregularly, but may be organized into interrupted lines or streaks. A well-defined broad black upper lateral stripe runs from the eye back to the hindlimb where it becomes broken up. A prominent moderately wide pure white mid-lateral stripe begins on the upper labials and runs under the eye above the forelimb and along the trunk to the hindlimb. Usually there is also a narrow irregular black lower lateral stripe below the mid-lateral stripe. Ventral surface unmarked silver white. Adult males in breeding condition develop a bright orange throat. The tail of juveniles is red-orange, not pale fawn as recorded by Smyth (1972), adults have brown tails.
Distribution: Drier areas of S Northern Territory; S Queensland; New South Wales; NW and N Victoria; South Australia; and SE Western Australia. (Figure 2.).

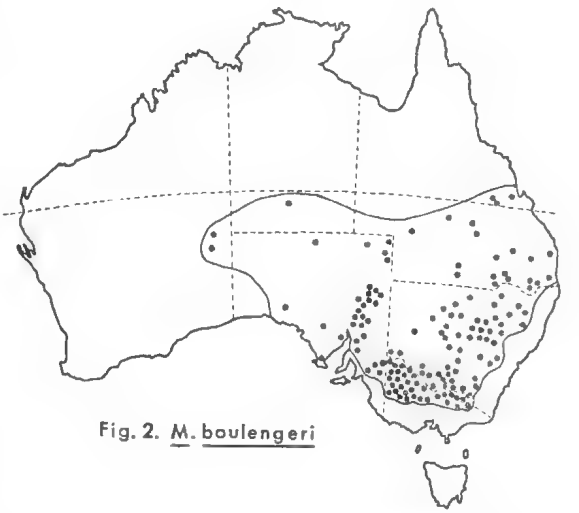

Fig. 2. M. boulengeri

Literature Records: See lists in Smyth (1972) and Storr (1972).
Specimens Examined: Northern Territory: (NMV) Illamurta, James Range, D 473: *Queensland:* (AM) Retro Station, Capella, R 12099 (2 specimens); R 12100 (2 specimens); R 12114 (3 specimens): Mungindi, R 15073; R 19083: Cunnamulla, R 17121; R 18464: Gilruth Plains, Cunnamulla, R 20662-3: 8 km

S of Claremont, R 21312: Glenmorgan, R 21317: (NMV) Queensland, D 104: 5 km W of Amiens, D 9384: (QM) Bell, Darling Downs, J 2305-9: Retro Station, Capella, J 6232; J 15768: 24 km W of St. George, J 10456-7: 69 km S of Blackall, J 11564: Wivenhoe Bridge, Brisbane River Valley, J 11853: 24 km N of Mitchell, J 11854: Bryden, J 11855: Green swamp, 45 km E of Roma, J 11856; J 11954: Murphy's Lake, Taroom, J 11858: 6 km S of Ferndale, J 11859-60: Wivenhoe Bridge, 8 km N of Wivenhoe, J 11862-3: 10 km W of Westgrove HS., NW of Gympie, J 11864: 1½ km W of Westgrove HS., NW of Gympie, J 11865: Win dorah, J 11866-8: Waratah Station via Cunnamulla, J 11869-71: Alum Rock Station via Amiens, J 11872: 16 km SE of Capella, J 11953: 8 km N of Stanthorpe, J 11955: Goondiwindi, J 13682: Jandowae, J 13773; J 13775-6; J 13778-81: Gilruth plains Field Station, Cunnamulla, J 14353: Batheaston Station, 128 km NW of Marlborough, J 15635-7: 35 km N of Augathella, J 21609: 88 km NW of Tamboo, J 21610; Binga Station via Cunnamulla, J 21946: Amiens near Stanthorpe, J 22316: Jollys Falls via Stanthorpe, J 22476: *South Australia* (AM) Port Lincoln, R 4764: (NMV) Purnong, D 1216: Overland Railway to Western Australia, D 3058: Whyalla, D 7743; D 7979-80: Alligator Gorge, Flinders Range, D 15220-2: Wertalona, D 41542: *New South Wales* (AM) Cootamundra, R 687-91; R 950: Brawlin, R 823; R 825-6: Narrabri, R 1042; R 1058: Western New South Wales, R 1073-4: Nidgera Ck., near Cootamundra, R 1745: Dubbo, R 1750-61: Narromine, R 1780: Boggabri, R 2023; R 2025; R 4169: near Liverpool, R 2174-5: Guntawang, R 3976: Nevertine to Warren, R 4871: Buddah Lakes, Trangii, R 5447: Penrose Farm, Bathurst, R 6268: Moloch, R 6443: Darling R., between Bourke and Wilcannia, R 6457: Belubula, R 8077: Jaffa, Ashford Downs, R 9413: Yaneo district, R 10646: Yaneo Agricultural School, R 10648: Walcha, R 10769: Cuddie Springs, Brewarrina, R 11006: Bullerana, Moree, R 11054: Pilliga, R 11591: Bringagee, R 13432: Mootwingie Waterholes, R 14678-9: Warrumbungle Mountains, R 14973; R 18921; R 21076: Quambone, R 15120; R 18722; R 18728; R 18753-4; R 18783: 21 km W of Byrock, R 15212: 24 km W of Byrock, R 15621: Moulamein, R 15841: Brewarrina, R 17674; R 18727: Lake Narran, R 17658; R 17711: Bourke, R 17886: Tocumwal, R 18143-5: Balranald, R 18146-8: Murray R., Moama, R 20357: Nymangee, R 20572; R 20642-3: 72 km W of Cobar, R 27409-10: Round Hill Fauna Reserve, between Lake Cargelligo and Mt. Hope, R 27825; R 27834; R 27839-40; R 27862-4; R 27904; R 29669: Old Harbour Lagoon, near Eumungie, R 28021-2; R 280 24-6: between Tilpa and Barnato, R 28093: Coonabarabran, R 28095: Duck Ck., 48 km W of Warren, R 28160: 67 km S of Gilgunnia, Eubalong Rd., R 28341; R 28347-8: 32 km S of Cobar, R 29560: Yalgorgrin State Forest, 11 km ex. Gilgandra, R 29645: Lachlan R., 11 km N of Lake Cargelligo, R 30385-7: 64 km S of Gilgunnia, Mt. Hope to Eubalong Rd., R 30391: Moonabi Lookout, Moonabi Ranges, R 31741-2: 37 km W of Armidale on Bundarra Rd., R 31769; R 31785: 24 km W of Gilgandra, R 33087-98; R 33100-6: (NMV) Finley, D 152: Brawlin, D 749-51: Nyngan, D 10591: Gin Gin, D 10603: Tor Downs, SW of Menindee, D 10610-1: Moorna, D 12167: 16 km N of Albury, D 14641-2: Savernake Station, Savernake, D 15043-8; D 15061-3: Boat Rock Hill, Savernake, D 15065-6: 8 km S of Corowa, D 15067-77: 6½ km SW of Savernake, D 15081: Mulwala, D 15086-7: Warrumbungle National Park, D 15091: 6½ km S of Morandah, D 15092: 14½ km NE of Urana, D 15130: 3 km NE of Jerilderie, D 15131: 14½ km NE of Jerilderie, D 15132: 3 km N of Tocumwal, D 15133: Tocumwal, D 15134: 10 km N of Cowra, D 15135: Boree Creek, D 15136-8; D 15142-5: 21 km SE of Jerilderie, D 15139-41: Sloane, D 15146: 13 km SE of Jerilderie, D 15147: 10 mls N of Barham, D 15178-92: 90 km W of Wentworth, D 15850: 24 km NNE of Wentworth, D 40180-1: *Victoria* (AM) Browns Plains, R 3988: (NMV) Murray River, D 917: Ouyen, D 810-1; D 950: Mildura, D

848; D 15218-9: Victoria, D 945: Elmore, D 1002: Bright, D 1065; D 1067; D 1069: Templestowe (in error) D 1237: Dimboola, D 1724; D 2207: Goulburn Valley, D 1808: Glenrowan, D 1819; D 2517: near Melbourne (in error) D 2508: Cowangie, D 2717: Grampians, D 3315-6: Kewell, D 3321-3: Red Cliffs, D 7966; D 7968: Sea Lake, D 9104-5: Pink Lakes, Linga, D 10713: Birthday Tank, Sunset Country, D 11185-6; D 33305; D 44865; D 47407: Wood Wood, D 13948-9: Taminick Gap, Warby Ranges, D 14553-63; D 14573-5: Warby Ranges, D 14610: Specimen Hill, Byawartha, D 14635: 8 km S of Kiata, Little Desert, D 14911-5; D 14984: 8 km SW of Kiata Little Desert, D 14953: 8 km SW of Natimuk, D 15042: Walpeup, D 150 49-50: 13 km N of Underbool, D 15051-2: 10 km SE of Wycheproof, D 15053: 13 km E of Yarrawonga, D 15082: 6½ km S of Nathalia, D 15083: 13 km S of Yarrawonga, D 15084-5: Kenmere, D 15088: 16 km SW of Nathalia, D 15089-90: Tutye, D 15097-103: Pine Plains, D 15104-5: 13 km E of Patchewollock, D 15106: Axedale, D 15108: 4 km E of Mildura, D 15109: Wemen, D 15110: 4 km NE of Wemen, D 15111: 4 km NE of Mildura, D 15112: 7 km WSW of Leitchville, D 15113-5: 35 km NW of Nyah, D 15116: Hattah, D 15117: Mildura Airport, D 15118-29: Lindsay Point Station, D 15148: 5 km E of Neds Corner Station, D 15149-53; D 15157-8: 6½ km E of Neds Corner Station, D 15154-5: 6½ km NW of Neds Corner Station, D 15156: Neds Corner Station, D 15159: Kerang, D 15160-2; D 15164: 5 km N of Eaglehawk, D 15165-6: 6½ km NE of Wahgunyah, D 15167-72: 6½ km E of Talgarno, D 15173: 29 km N of Swan Hill, D 15176: Nyah, D 15193: 3 km E of Hattah, D 15194-206: Tower Hill, Grampian Ranges, D 15208: 5 km NW of The Crater, Little Desert, D 15210-3: 6½ km N of The Crater, Little Desert, D 15209: Manangatang, D 15214-6: Tiger Hill via Tatong, D 17710-7: between Perry and Birthday Tanks, Sunset Country, D 18064-6: 1½ km E of Birthday Tank, Sunset Country, D 18076: 7 km W of Nowingi, D 18102-4: Tank, 6½ km E of Birthday Tank, Sunset Country, D 18165: SW bank of Rocket Lake, Sunset Country, D 18168: between Monkeytail and Perry Tanks, Sunset Country, D 18173: Stockyards between Perry and Birthday Tanks, Sunset Country, D 18175-9: Stockyards, Sunset Tank, Sunset Country, D 18184-5: 5 km NE of Sunset Tank, Sunset Country, D 18233: 1 km E of Sunset Tank, Sunset Country, D 18234: 24 km E of Birthday Tank, Sunset Country, D 33304: 1 km S of Millewa South Bore, Sunset Country, D 33347: 14½ km NE of Millewa South Bore, Sunset Country, D 33350-1: Millewa South Bore, Sunset Country, D 33354: Pound Bend, Wemen via Robinvale D 33358-60: Kulkyne Freehold, D 33528-30: 6½ km SE of Pine Plains, D 33536: 5 km E of Broughton, Nhill Rd., D 33638-43: 1½ km N of Freuds Plain, Wyperfeld National Park, D 38799: Main Gate, Wyperfeld National Park, D 38800-5: 3 km W of Yanac, D 38818: Sunset Tank, Sunset Country, D 38853; D 38860-1: 3 km E of Perry Tank, Sunset Country, D 38856: 3 km N of Bendigo, D 44834-6: Mildura, D 40141-2: 11 km WNW of Annuello, D 47343-4: 11 km S of Boundary Bend, D 47354-6:

Morethia butleri (Storr 1963)

(Fig. 3)

Ablepharus butleri Storr, 1963, *W. Aust. Nat.* **9**: 46-47.
Morethia butleri Smyth, 1972, *Rec. S. Aust. Mus.* **16**: 1-14. Fig. 3.
——— Storr, 1972, *J. R. Soc. W. Aust.* **55**: 73-79. Figs. 1, 2.

Holotype: WAM R 20615, Western Australian Museum, Perth. Locality: Leonora, Western Australia, 28° 52′ S., 121° 23′ E. Collectors: G. M. Storr and R. E. Moreau.

Description: See Storr (1963).

Diagnosis: Six (rarely seven) supraciliaries, the first the largest and the remainder forming a decreasing series; junction of supraciliaries, with supraoculars linear or slightly curved. Subdigital lamellae acutely keeled and unicarinate. Palmar tubercles apically acute.

Description: (After Smyth (1972) and Storr (1972)) Snout-vent length 25-56 mm. Intact tail 134-169% of snout-vent length. Suprana-

sals present, widely separated. Postnasals present but often fused to supranasals. Prefrontals separated. Frontonasal wider than long. Frontal longer than wide. Two to five ear lobules (usually two or three). Midbody scales in 26-31 rows (usually 28 or 30), mean 28·9. Lamellae under fourth toe 19-27, mean 22·4. *Colour:* Dorsal surface dark olive-green to olive-brown sometimes flecked with black, but usually unmarked. Broad black upper-lateral stripe may be distinct and well developed or virtually absent except anteriorally. The white mid-lateral stripe is equally variable, it may be distinct and well developed or only readily distinguishable anteriorally. Lips dark spotted. Storr (1972) records that the tail (as with *M. boulengeri*) is red in juveniles and brown in adults.

Distribution: Arid and semi-arid parts of S Western Australia and possibly SW South Australia S of 27° 30′ S. Not known from any other part of Australia. (Figure 3.).

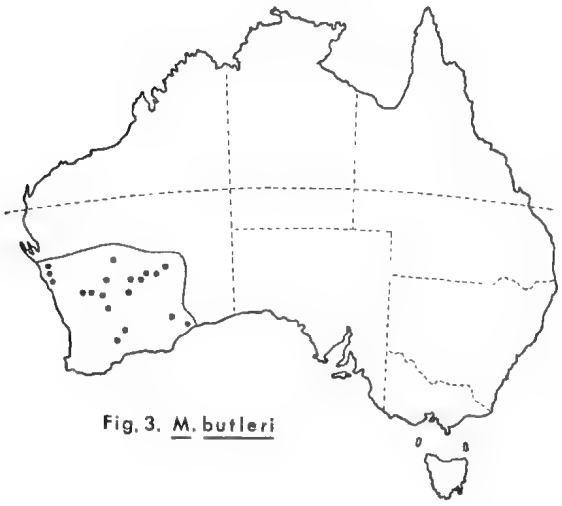

Fig. 3. M. butleri

Literature Records: See lists in Smyth (1972) and Storr (1972).

Specimens Examined: South Australia (NMV) Overland Railway to Western Australia, D 2654: *No Data* (AM) R 38652.

Morethia lineoocellata (Dumeril and Bibron 1839)

(Fig. 4)

Ablepharus lineoocellatus (part) Dumeril and Bibron, 1839 *Erpetologie Generale* **5**: 817. Paris.
Morethia anomalus (part) Gray, 1845, *Catalogue of lizards*: 65.
Ablepharus lineoocellatus A var. *lineoocellatus* Boulenger, 1887, *Catalogue of the Lizards in the British Museum (Natural History)* **3**: 348-349.
Ablepharus lineoocellatus B var. *anomalus* (part) Boulenger, 1887 *Ibid.* **3**: 48-349.
Ablepharus lineoocellatus Zietz, 1920, *Rec. S. Aust. Mus.* **1**: 220-221.
Ablepharus lineoocellatus lineoocellatus Loveridge, 1934, *Bull. Mus. Comp. Zool.* **77**: 377.
Morethia lineoocellata Fuhn, 1969, *Z. Zool. Syst. Evolutionsforsch.* **7**: 67-76. Fig. 7.
Morethia lineoocellata Storr, 1972, *J. R. Soc. W. Aust.* **55**: 73-79. Figs. 1, 3.

Type Series of **Ablepharus lineoocellatus,** Dumeril and Bibron, 1839

Remarks: Five specimens (not four as listed by Guibe, 1954) in the Museum National d'Historie Naturelle, Paris: MNHP 3092 (old number 3101). Locality: Nouvelle Hollande. No other data. Two distinct species are represented in the type series which was not examined by either Smyth or Storr. Three of the syntypes are referable to *M. lineoocellata sensu* Storr. The first of these syntypes (the largest) fits Storr's definition of *M. lineoocellata* in all respects, this specimen is designated as lectotype below. The second syntype has a partially separated supranasal scale which is characteristic of Storr's *M. obscura,* but not exclusive of *M. lineoocellata,* this specimen otherwise fits Storr's definition of the latter species. The third syntype is aberrant, it has five supraciliaries owing to the fusion of the first and second, and it fits Storr's definition of *M. obscura* in one respect, for the third last supraciliary is the largest and the last three supraciliaries form a rapidly decreasing series. However, this specimen lacks supranasal scales which are characteristic of *M. obscura.* The remaining two syntypes are conspecific and distinct from either *M. lineoocellata* or *M. obscura;* both specimens are readily referable to *Menetia greyi* Gray 1845 (see below).

In order to restrict the use of the name *Morethia lineoocellata* and preserve Storr's

nomenclature, the first syntype listed above which fits Storr's definition exactly is selected as lectotype here.

Lectotype: MNHP 3092 (Old No. 3101), Museum d'Historie Naturelle, Paris.

Locality: Nouvelle Hollande (=Australia). No other data.

Description: Snout-vent length 42 mm. Tail (intact) 51 mm, 121% of snout-vent length. Length of forelimb, 12 mm; length of hindlimb, 18 mm. Snout-axilla, 10 mm; axilla-groin, 24 mm. Six supraciliaries, third, fourth and fifth subequal in size and penetrating deeply between the supraoculars; sixth supraciliary the smallest. Supranasals fused to nasals. Postnasals present. One ear lobule. Seven upper labials, the fifth largest and entirely subocular; six lower labials. One pair of nuchals. Eight preanals, four slightly enlarged. Smooth scales, 26 rows round midbody. Subdigital lamellae smooth, 19 under the fourth toe. Palmar tubercles apically rounded.

Colour: Dorsal surface olive-brown with two rows of rather indistinct black and white ocelli. Dorsolateral row of indistinct black and white ocelli. Black upper lateral band runs from nostril through the eye, above the forelimb and along trunk to tail. Distinct white mid-lateral stripe runs from upper lip through ear and above fore and hind limbs to tail. Black lower lateral band runs below white mid-lateral stripe, merges into grey lower lateral region. Ventral surface pure white unmarked.

Paralectotypes: Four specimens also under MNHP 3092 (Old No. 3101), Museum d'Historie Naturelle, Paris.

Locality: Nouvelle Hollande. No other data.

Paralectotype (a): Snout-vent length 35 mm; tail (regrown) 41 mm; length of forelimb 11 mm; length of hindlimb 16 mm; snout-axilla 13 mm; axila-groin 20 mm. Scalation as for lectotype except: supranasal only partially separated from nasal; 24 rows of scales round midbody; 18 lamellae under the fourth toe; ten preanal scales, four slightly enlarged. Colour as for lectotype except: each of the two dorsal rows of black and white ocelli have fused to give continuous white lines margined by broken black lines on the trunk ad tail; and on each side the dorsolateral row of ocellations have also fused to given a continuous white dorsolateral stripe margined above and below on the trunk by black. This specimen is conspecific with the lectotype.

Paralectotype (b): Snout-vent length 41 mm; tail (regrown) 19 mm; length of forelimb 11 mm; length of hindlimb 17 mm; snout-axilla 9 mm; axilla-groin 20 mm. Scalation as for lectotype except: five supraciliaries owing to the fusion of the first and second, second and third the largest, only the second and third penetrate deeply between the supraoculars, and the third, fourth and fifth form a rapidly decreasing series (this condition which resembles that in *M. obscura* is apparently caused by abnormal reduction of the fourth supraciliary); 26 rows of scales round midbody; 20 lamellae under the fourth toe; five lower labials. Colour as for lectotype. Supranasal scales fused to nasals. If Storr is correct that supranasals are invariably present in *M. obscura,* this specimen is conspecific with the lectotype.

Paralectotype (c): This specimen is neither conspecific nor congeneric with the lectotype, and it differs in the following characters: snout-vent length 29 mm; tail (broken) 5 mm; length of forelimb 6 mm; length of hindlimb 9 mm. Four fingers and five toes. Scalation greatly different: all supraciliaries fused into a single elongate shield; two supraoculars, the anterior very large and elongate, the posterior small; 18 scale rows round midbody; 16 lamellae under the fourth toe. Colour as for *Menetia greyi* Gray (see Boulenger 1887). This specimen is conspecific with the syntypes of *Menetia greyi* Gray (BMHN X.1.7. a-e; RR 1946.8.15.1-14 and 1946.8.16.88-99) and is referable to that species.

Paralectotype (d): Description as for paralectotype (c) except: snout-vent length 27 mm; tail (broken) 3 mm; length of forelimb 6 mm; length of hindlimb 9 mm; 18 scale rows round midbody; 17 lamellae under the fourth toe. This specimen, is also conspecific with the syntypes of *Menetia greyi* Gray (see above) and is referable to that species.

Type Series of **Morethia anomalus** Gray, 1845

Remarks: Gray (1845) described this species from two specimens in the British Museum collection (BMNH) XI.6a-b; RR 1946.8.15. 74-75). Storr (1972) designated one (BMNH XI. 6b; RR 1946.8.15.75) as lectotype, thus making *M. anomalus* a junior subjective synonym of *M. lineoocellata,* but did not comment on the identity of the other syntype. The author has re-examined Gray's two syntypes and determined that they belong to different species: the lectotype is conspecific with the lectotype of *M. lineoocellata* which is designated and described above; but the paralectotype is conspecific with Storr's (1972) *M. obscura* described at the same time that the lectotype of *M. anomalus* was designated.

Lectotype: Storr (1972): BMNH XI.6b; RR 1946.8.15.75, British Museum of Natural History, London. Locality: West Australia. Collector: Mr. Gilbert. No other data.

Description: Snout-vent length 43 mm. Tail (intact) 63 mm, 149% of snout-vent length. Length of forelimb, 11 mm; length of hindlimb, 17 mm. Snout-axilla 9 mm; axilla-groin, 25 mm. Six supraciliaries, third, fourth and fifth equal in size and penetrating deeply between the supraoculars; sixth supraciliary the smallest. Supranasal separate from nasal. Postnasals present and separate from supranasal. One ear lobule. Eight upper labials, sixth the largest and entirely subocular; seven lower labials. One pair of nuchals. Eight preanal scales, four slightly enlarged. Smooth scales, 26 rows round midbody. Subdigital lamellae smooth, 20 under the fourth toe. Palmar tubercles apically rounded.

Colour: Very faded due to preservation. Dorsal surface light brown, ocellations not visible. Light dorsolateral stripe faintly visible. Black upper lateral band and white midlateral stripe faintly visible. Ventral surface unmarked, white.

This specimen is conspecific with the lectotype of *M. lineoocellata* (MNHP 3092) described above. As Storr (1972) did not examine the syntypes of *M. lineoocellata* when he designated the lectotype of *M. anomalus* and placed it in the synonymy of *M. lineoocellata,* his decision was apparently based only on the written description of the latter species. The author has examined Storr's lectotype of *M. anomalus* and found it to be conspecific with the lectotype of *M. lineoocellata* so Storr's action is now verified.

Paralectotype: BMNH XI.6a; RR 1946.8.15. 74, British Museum of Natural History, London. Locality: West Australia. Collector: Mr Gilbert. No other data.

Description: Snout-vent length 50 mm. Tail (broken) 7 mm. Length of forelimb, 12 mm; length of hindlimb, 19 mm. Snout-axilla, 15 mm; axilla-groin 30 mm. Six supraciliaries, fourth the largest and fourth, fifth and sixth form a rapidly decreasing series; the third and fourth supraciliaries penetrate deeply between the supraoculars. Supranasals separate from nasals. Postnasals present and separate from supranasals. Three ear lobules. Seven upper labials, fifth largest and entirely subocular; six lower labials. One pair of nuchals. Eight preanal scales, four slightly enlarged. Smooth scales, 26 rows round midbody. Subdigital lamellae smooth, 18 under the fourth toe. Palmar tubercles apically rounded.

Colour: Very faded due to preservation. Dorsal surface light olive-grey, ocellations not visible. Black upper lateral band faintly visible. Ventral surface unmarked, white.

This specimen is not conspecific with the lectotype of *M. lineoocellata,* but it is conspecific with Storr's species *M. obscura* (see *below*) and fits Storr's description of that species exactly.

Diagnosis: Six supraciliaries (occasionally five owing to fusion of first and second), the third, fourth and fifth subequal and penetrate deeply between the supraoculars; the sixth supraciliary the smallest. Supranasals usually fused to the nasals. Subdigital lamellae smooth or obtusely keeled. Palmar tubercles apically rounded.

Description: (After Smyth (1972) and Storr (1972)). Snout-vent length 19-49 mm. Intact tail 111-247% of snout-vent length. Supranasals normally fused to nasals or separated only by a shallow or incomplete groove. Postnasals normally present but only separated from nasal by a faint groove. Frontonasal wider than

long. Frontal longer than than wide. One to three ear lobules. Midbody scales in 24-31 rows (usually 26 or 28), mean 27·3. Lamellae under the fourth toe 16-26, mean 19-7.

Colour: Head coppery brown. Dorsal surface green, olive-grey or olive-brown, usually marked with white ocelli outlined in black. Ocelli may be absent or modified into black or white spots which sometimes fuse into longitudinal stripes. White dorsolateral stripe present. Irregular dark brown or black upper lateral band. White midlateral stripe margined by black below usually well developed, runs through ear, over forelimb and along trunk to hindlimb.

Distribution: On the mainland restricted to two coastal areas in the SW of Western Australia: the mid-west coast from Port Cloates S to Geraldton; and the lower W coast from just N of Perth S to Cape Leeuwin and a short distance inland. Also occurs on islands of the Montebello Group and Houtmans Abrolhos, and from Rottnest and Garden Islands. Distribution inland very limited. Not known from any other Australian state. (Figure 4.).

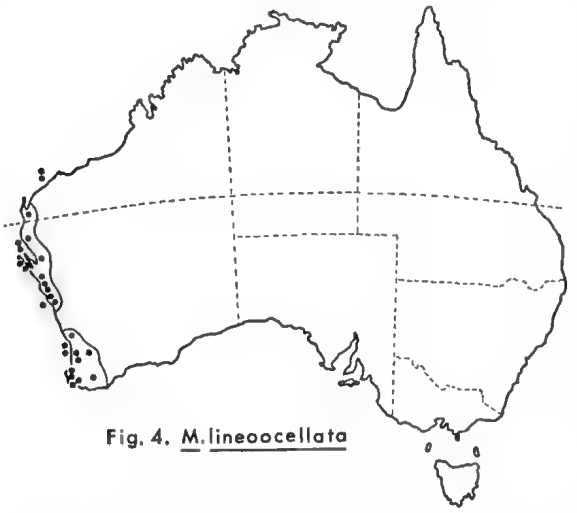

Fig. 4. M. lineoocellata

Literature Records: See list in Storr (1972).

Specimens Examined: Western Australia (AM) Bunbury, R 30343: (QM) Rottnest Island, J 12241:

Morethia obscura Storr 1972

(Fig. 5.).

Morethia anomalus (part) Gray, 1845, *Catalogue of lizards*: 65.

Ablepharus lineoocellatus B var. *anomalus* (part) Boulenger, 1887, *Catalogue of the Lizards in the British Museum (Natural History)* **3**: 348-349.

Ablepharus lineoocellatus (part) Zietz, 1920, *Rec. S. Aust. Mus.* **1**: 220-221.

Ablepharus lineoocellatus anomalus (part) Loveridge, 1934, *Bull. Mus. Comp. Zool.* **77**: 377-378.

Morethia lineoocellata Smyth, 1972, *Rec. S. Aust. Mus.* **16**: 1-14. Figs. 4, 6.

Morethia obscura Storr, 1972, *J. R. Soc. W. Aust.* **55**: 73-79. Figs. 1, 3.

Holotype: WAM R 16916, Western Australian Museum, Perth. Locality: 6 miles east of Kalamunda, Western Australia, 31° 58′ S, 116° 08′ E. Collector: Mr John Dell. Date of collection: November 7, 1962.

Description: See Storr (1972).

Remarks: M. obscura, described by Storr in 1972, is very closely related to *M. lineoocellata.* Neither Smyth nor Storr examined the syntypes of *M. lineoocellata* though both used the name in their reviews. Smyth recorded and described specimens from South Australia under this name. However, he expressed reservations as he noted that South Australian specimens differed from many Western Australian specimens in several respects viz.: the invariable possession of supranasal scales; having the fifth supraciliary smaller than the fourth; and having only the third and fourth supraciliaries penetrate between the supraoculars. Smyth noted that Gray (1845) described *M. anomalus from* 'W Australia' and distinguished it from *M. lineoocellata* because the former, but not the latter, had supranasal scales. Smyth did not use the name *M. anomalus* for South Australian specimens as he doubted that the presence or absence of supranasal scales on its own was a good indication of a species. He suggested that a careful study of Western Australian material was needed as both *lineoocellata* forms occurred there and stated that this could result in the recognition of two species. Storr carried out such a study and separated the new species *M. obscura* from *M. lineoocellata* using the condition of the supraciliaries described by Smyth and the presence of supranasal scales as the major diagnostic characters. All eastern Australian specimens, including those described by Smyth as *M. lineoocellata,* have proved to be *M. obscura.*

The nomenclature of the species presently recognized in the genus *Morethia* has now become very confused, especially in the *lineoocellata* group. Literature records of *M. lineoocellata* prior to Smyth and Storr could include any, or all, of the 'southern' species of *Morethia* and should be disregarded unless they can be verified. Particularly confusing is the history of the species *M. anomalus* described by Gray (1845) from Western Australia. As mentioned above, Gray distinguished the species from *A. lineoocellatus* because it possessed supranasal scales. Boulenger (1887) after examining material in the British Museum which included Gray's types of *M. anomalus,* applied the name *Ablepharus lineoocellatus anomalus* to specimens with supranasal scales. Authors from that time mainly followed Boulenger (e.g. Loveridge, 1934 and used the name *anomalus* for the more eastern populations of *M. lineoocellata* which possess supranasal scales (i.e. Storr's *M. obscura*), though, as Smyth notes, most authors were probably also including *M. adelaidensis* and *M. boulengeri* under this name. As recorded above, there were two syntypes of Gray's *M. anomalus,* the lectotype (BMNH XI. 6b, RR 1946.8.15.75) which is conspecific with *M. lineoocellata sensu stricto,* and the paralectotype (BMNH XI.6a, RR 1946.8.15.74) which is conspecific with Storr's new species *M. obscura.* The name *M. anomala* could have been retained if the paralectotype had been nominated instead as lectotype for the taxon. This would also have preserved recent usage of the name. It is unfortunate that the name *anomalus* has been placed in the synonymy of *M. lineoocellata* and a new name, *M. obscura,* has been introduced. It must be stressed again that in Smyth's review, the name *M. lineoocellata* was applied to specimens which now properly belong in Storr's species *M. obscura* and all Smyth's descriptions etc. apply to this latter species.

Diagnosis: Six supraciliaries (rarely five owing to the fusion of the first and second), fourth the largest, and the fourth, fifth and sixth form a rapidly decreasing series, the third and fourth (and rarely the fifth) penetrate between the supraoculars, sixth the smallest. Supranasals invariably present. Subdigital lamellae smooth or obtusely keeled and unicarinate; palmar tubercules apically rounded.

Description: Snout-vent length 18-56 mm, mean 43 mm. Total length of adults with intact tails 107-129 mm, mean 117 mm. Intact tail 120-189% of snout-vent length. Supranasals and postnasals always present but often fused to each other or only separated by a shallow groove. Supranasals widely separated. In most specimens the third and fourth supraciliaries penetrate between the supraoculars, the fourth is largest, and the fourth, fifth and sixth are successively smaller; but rarely the fifth supraciliary is nearly as large as the fourth and it also penetrates between the supraoculars. Frontonasal wider than long. Frontal longer than wide. One pair of nuchals. One to four ear lobules. Midbody scales in 24-31 rows (usually 26 or 28), mean 27·7. Lamellae under the fourth toe 14-23, mean 19·0.

Colour: Olive-brown to olive-grey dorsal surface, usually with dorsal ocellations which consist of a single scale with the middle third white and the outer thirds black. The dorsal ocellations are rarely bold or numerous, and may be reduced to black flecks or be absent altogether. Occasionally there is a trace of a pale dorsolateral stripe. Broad irregular black upper lateral stripe. Narrow pale irregular mid lateral stripe usually present, running from eye through ear over forelimb and back to hindlimb. The upper lateral and mid lateral stripes are not as even or bold as those in *M. boulengeri.*

Distribution: Arid and semi-arid areas of SW New South Wales; NW Victoria; S South Australia and offshore islands; and S Western Australia. (Figure 5.).

Literature Records: See lists in Smyth (1972 as *M. lineoocellata*) and Storr (1972).

Specimens Examined: Western Australia: (AM) Perth, R 2457; Western Australia, R 6483; Bornham, R 7689; Cranbrook, R 7690; Merredin, R 9152; Eradu near Geraldton, R 9164; Woodlands, Tambellup, R 11121; R 11666; Northam, R 12350: *South Australia:* (NMV) Purnong, D 1546-51, D 3076; Lake Wangary, Eyre Peninsula, D 15058: *New South*

Wales: (AM) Nymangee, R 17675; Round Hill Fauna Reserve between Lake Cargelligo and Mt. Hope, R 27860; R 27869; R 27823-4; R 27833; R 27838; R 27883-4; R 29670-1; 8 km W of Nymangee, R 18481: *Victoria:*

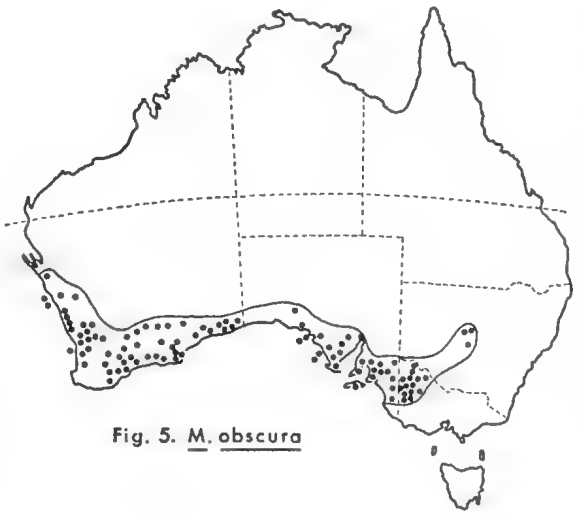

Fig. 5. M. obscura

(NMV) Raak Plains D 698; Ouyen, D 1040; D 2416; Red Cliffs, D 7969; Kiata, Little Desert, D 8958; Pink Lakes near Ouyen, D 9473-4; Kooloonong, D 13951; Broughtons Waterhole, Little Desert, D 14917-29; 1½ km NE of Broughtons Waterhole, D 14930-1; D 14937; 8 km S of Broughtons Waterhole, D 14932-3; D 14935; D 14942-3; D 14945; D 14947-8; 1½ km E of Broughtons Waterhole, D 14934; D 14936; D 14940; D 14944; D 14946; 1½ km W of Broughtons Waterhole, D 14938; 5 km E of Broughtons Waterhole, D 14939; 3 km NNE of Broughtons Waterhole, D 14941; Stan's Camp, Little Desert, 22½ km SW of Nhill, D 14949-50; 16 km N of Goroke, Little Desert, D 14951-2; 14½ km S of Murrayville, D 18235; Spring, 48 km S of Murrayville, D 18236; SA-Vic. border due W of Telopea Downs, Big Desert, D 38819; Red Bluff, Big Desert, D 38822; D 40174-5; The Springs, Big Desert, D 38831; 15 km E of Broughton, NW of Nhill, D 44866: 6 km S of Dimboola, D 44867: Little Billy Bore, Big Desert, D 47392-3: *No accurate data* (AM) R 39455.

Ecology

Detailed laboratory studies have been made only on *M. boulengeri*. Field observations show *M. adelaidensis* and *M. obscura* to be similar to *M. boulengeri* and, from the distributions of *M. butleri* and *M. lineoocellata*, it is considered that they would also be broadly similar.

M. boulengeri is a heliothermic, insectivorous skink. The species has high thermal preferences compared to other skinks from other temperate areas (Rawlinson, 1974 a,b; 1975). The voluntary minimum temperature is 29·95°C, the mean preferred temperature is 34·09°C, and the voluntary maximum temperature is 39·35°C.

Habitat preferences have not received any detailed attention. However, it is possible to state that all species live in open vegetation forms ranging from semi-desert to woodland. *Morethia* species are generally restricted to areas where mean annual rainfall is less than 50 cm.

Reproduction

M. adelaidensis, M. boulengeri and *M. obscura* are all oviparous, but details are known only for *M. boulengeri*. Unlike the majority of lygosomid skinks from cool temperate areas, this species does not show obligatory sperm storage overwinter (Rawlinson, 1974 b). Ovarian and testicular activity commences in early spring (September to October) and ovulation occurs in late October to early November. Copulation and fertilization also occurs at this time. The fertilized eggs are retained in the oviducts until late January or early February when they are laid in an advanced state of development. Clutch size varies from 3 to 5 with a mean of 3·5 (11 observations).

Relationships

There is no doubt that the five southern species of *Morethia* are all closely allied and that with the northern *(M. taeniopleura)* group they form a good genus. The relationships of the genus have been discussed several times recently (see Greer 1974 and included authors). Greer recorded that the *Morethia* species have an 'alpha' lygosomid palatal bone pattern that

fits them into his 'Group II' of *Leiolopisma*-like genera. On this basis he concluded that the closest Australian genera are *Anotis, Cryptoblepharus, Emoia, Leiolopisma* and *Pseudemoia* (though he included the latter genus in *Leiolopisma)* and the present author agrees fully with this finding. However, using morphological criteria, Greer went on to construct a phylogeny in which the 'Group II' *Leiolopisma*-like genera were derived from an ancestral species close to *Pseudemoia spenceri* (which he placed in the genus *Leiolopisma*). Greer considered the genus to be the end of an evolutionary line that ran from a *Pseudemoia spenceri*-like ancestor through *Emoia* to *Cryptoblepharus* then *Morethia.* In a second lineage Greer considered that the genera *Anotis* and *Proablepharus* arose from *Leiolopisma* via the same *Pseudemoia spenceri*-like ancestor. The present author considers this phylogeny to be unlikely as it involves the evolution of five oviparous genera *(Anotis, Cryptoblepharus Emoia, Morethia and Proablepharus)* through two groups *(Pseudemoia* and *Leiolopisma)* that are placental, viviparous forms. Until full details of the biology and morphology of all 'Group II' *Leiolopisma*-like species are known, their origins, relationships and phylogeny must remain doubtful.

Discussion

The five southern species of *Morethia* present an interesting pattern of speciation in the temperate arid and semi-arid areas of Australia. However, until further details of the ecology of the various species are known, it is not possible to meaningfully comment on their biogeographic and evolutionary significance. When these details are known, the group will provide a radiation pattern to compare and contrast with other related lygosomid groups, the more mesic temperate genera *Lamprophol is, Leiolopisma* and *Pseudemoia,* and the tropical genera *Anotis, Cryptoblepharus* and *Carlia.*

Acknowledgements

The author thanks Dr H. G. Cogger of the Australian Museum, Mr A. J. Coventry of the National Museum of Victoria, and Ms J. Covacevich and Mr G. Ingram of the Queensland Museum, for help in locating specimens in the collections under their care. Ms A. Grandison, Dr E. Arnold and Mr A. Stimson of the British Museum of Natural History in London, Professor J. Guibe of the Museum National d'Historie Naturelle in Paris and Dr G. Peters of the Zoologisches Museum der Humboldt in Berlin all gave invaluable assistance in the location and examination of type specimens and associated data. Finally the author wishes to express sincere appreciation for the help given by various staff members of the National Museum of Victoria, especially to Mr A. J. Coventry and Mr T. A. Darragh for assistance with the manuscript and Mr J. McNally for allowing the facilities of the Museum to be used during the collection of data.

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A CREEPING CTENOPHORAN (PLATYCTENEA: CTENOPHORA) FROM VICTORIA, AUSTRALIA

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Summary

Specimens of a platyctenean ctenophoran tentatively identified as *Coeloplana willeyi*, Abbott, 1907, are described living on red and green algae at the southern end of Port Phillip Bay, Victoria. These constitute the first record of this group of animals from southern Australia and only the second record for Australia.

Introduction

During survey work at the southern end of Port Phillip Bay, Victoria, Mr Phil Hollis of the Underwater Research Group of Victoria discovered several specimens of a small creeping ctenophoran. These were discovered on detailed examination of minute algal faunas in an aquarium following collection of bottom growths from selected deep water areas in the Bay, and were brought in alive to the Museum where they were observed for several days. They were readily identified as platyctenean ctenophorans belonging to the genus *Coeloplana* by their creeping habit, the presence of two retractile pinnate tentacles, a central dorsal statocyst and the absence of swimming comb-plates.

This constitutes the first record for the Order Platyctenea for southern Australia and is only the second record for Australia, the other being for the Great Barrier Reef (Stephenson, 1931). Apart from an otherwise unpublished record by Dayton and Robillard for Antarctica 1968 (pers. comm. in Gordon, 1969) it is the most southerly record for this group of unusual animals.

MATERIAL

Four specimens were discovered on algal growth taken from 15·5 m in a tidal hole 1·5 km north of Portsea in the southern part of Port Phillip Bay, Victoria (38°19′ 5; 144° 45′ E). All specimens were found by Mr Phil Hollis, the first in December 1972 and three more in January 1973. The first and second specimens were found crawling on *Caulerpa* sp. while the others were on red algae. The samples in each case consisted largely of algae though some ascidians and other sessile animals were also present in small numbers. It is therefore not known with certainty on what substratum the animals were originally taken. However, they are not confined to one type of substratum and appear to be able to readily pass from one to the other.

Three specimens are preserved in 5% neutral formalin in the National Museum of Victoria, Reg. No. G2649.

DESCRIPTION

The animal has a very flat flexible body capable of extension in any direction, with a thicker central dome-like region. In the centre of this domed region is a statocyst, composed of a central granule suspended in a vesicle, which is overlaid by a section of the body wall. There is an aperture in the outer body wall, which is figure-8 shaped with a central constriction, the long-axis of the aperture being perpendicular to the inter-tentacular axis. This aperture can be opened and closed very rapidly, presumably by a sphincter muscle system. Surrounding the statocyst in the central area are several clear vesicles or pustules. On the few specimens examined these pustules vary in number from 8 to 25, ranging in size from three times as large as the vesicle containing the statocyst to approximately half its size, and in organization from a regular arrangement of radiating lines around the statocyst to a totally irregular arrangement.

There are two long pinnate tentacles capable of extension to 6 to 8 times the body diameter. These tentacles are completely retractable into two tentacular sheaths at opposite sides of the body in the central domed region. When the

tentacles are retracted the positions of the tentacular sheaths are barely discernible as slightly raised, smaller areas of the central dome region.

The overall body colour is a dark pink to orange-red with small pale or transparent areas and some white blotches. This appears to be made up of small red pigment spots and some white pigment spots in a largely transparent general body structure. Contraction of the body causes an intensification of the colour.

The ventral surface is flat, with less colour, giving the body a semi-transparent appearance. The general distribution of the main body organs can be seen through the ventral surface. The position of the tentacular sheaths can be seen and also a series of canals surrounding a meridional canal.

BEHAVIOUR

When crawling the animals expanded to 12 mm in diameter and the tentacles were capable of extending to at least six to eight times the body diameter. The animals were first observed crawling on the surface of green or red algae. Tentacles were streamed either together or independently and retracted intermittently. The animal crawled freely over the surface of the alga with no particular part leading. However, several independent observations were made of the body being bent round so that the two tentacular sheaths were positioned on the same side, allowing both tentacles to be streamed in the same direction.

The animal was dislodged from the alga and was observed to swim feebly by a series of undulating wave movements of the thin peripheral region. It was also observed to gain the surface film of water in a shallow dish and to float inverted on the surface film by completely expanding its under-surface. While floating in this manner the tentacles were fully streamed several times. On one occasion the tentacles touched the bottom of the dish and appeared to adhere to it for a short period. During this time they were slowly contracted, pulling the animal along.

When stimulated with a needle, when either crawling or floating, the tentacles were retracted very rapidly and completely. After a short period, either one or both were very slowly expanded in stages, each stage being interspersed with further rapid complete contractions. No feeding activity was observed.

IDENTIFICATION

Platyctenean ctenophorans have been recorded from many parts of the world, from Greenland (Mortensen, 1912) to Antarctica (P. Dayton and G. A. Robilliard 1968 in Gordon 1969), with records from practically every contient. However, they are still such rare and unusual animals that they have prompted study whenever they have been discoverd and many new taxa have resulted. This has been especially evident when a specimen has been discovered for the first time in a marine faunal zone or geographical region in which this group of animals has not previously been recorded. This phenomenon, coupled with the absence of any clearly defined taxonomically useful characters, has led to a proliferation of specific and generic names and taxonomic confusion.

Several partial revisions of the group, have been undertaken, principally by Dawydoff (1936, 1938), Komai (1934) and others, while a good general account is provided by Hymen (1940). Following this latter work the present specimens are referred to the genus *Coeloplana* because of the presence of erectile dorsal papillae, the absence of comb-plates, and because the statocyst and tentacles are in hidden tentacular sheaths. The specimens are tentatively identified as *Coeloplana willeyi* Abbott (1907), following Matthews and Townsley (1964) and Gordon (1969), because the size, colour and number of dorsal papillae fall within the variation range of this species. However it is recorded as such, more to provide a convenient label for future reference than with any idea of taxonomic exactitude.

Acknowledgements

We would like to thank Mr Phil Hollis for first discovering these animals and making them available for study.

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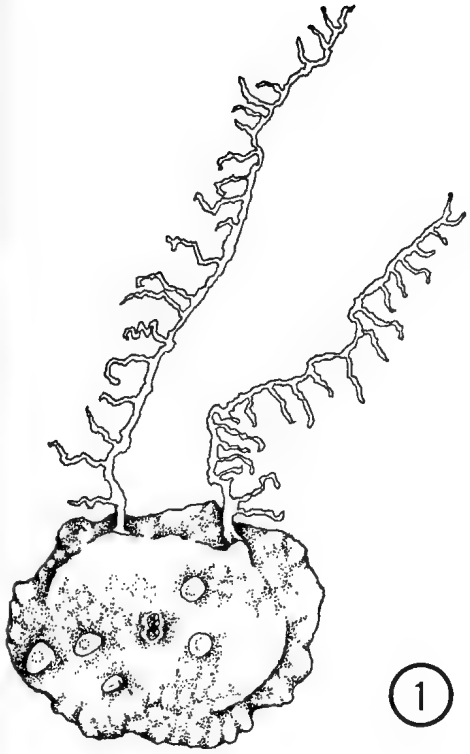

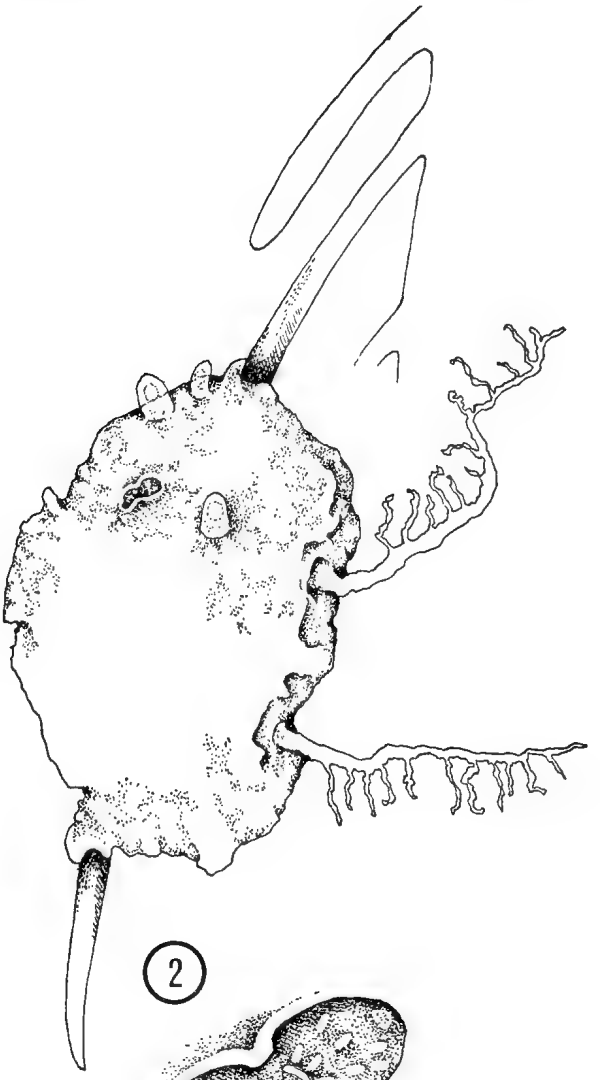

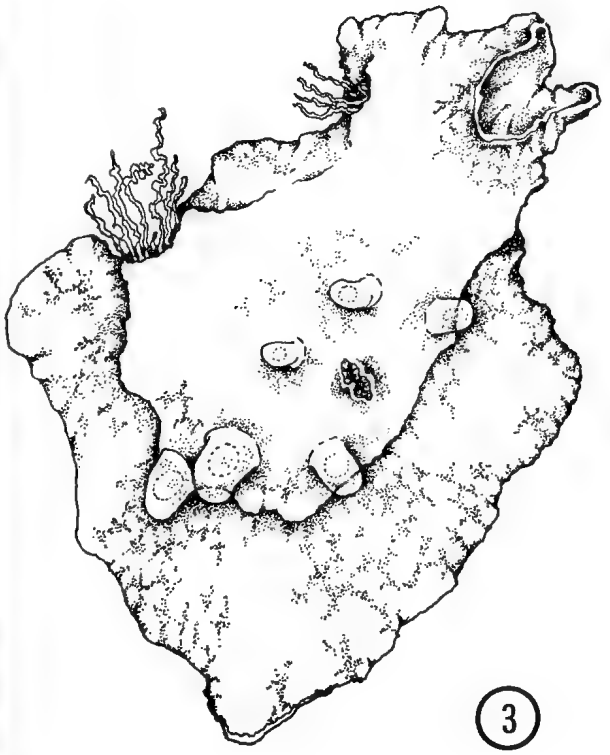

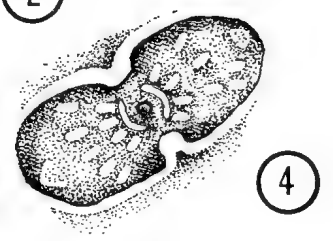

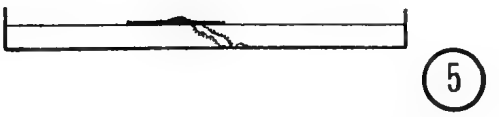

Figs. 1, 2 and 3—Series of drawings of *Coeloplana willeyi* Abbott of the living animal showing the general body shape and the tentacles.
Fig. 4—Central statocyst.
Fig. 5—Animal floating on surface film, using the tentacles for locomotion.

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SYMBIOCLADIUS AURIFODINAE sp. nov. (DIPTERA, CHIRONOMIDAE), A PARASITE OF NYMPHS OF AUSTRALIAN LEPTOPHLEBIIDAE (EPHEMEROPTERA)

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Summary

Symbiocladius aurifodinae sp. nov., an orthoclad chironomid parastic on nymphs of the mayfly genus *Atalophlebioides*, is described from mountain streams in Victoria. Descriptions are based on mature pupae and larvae collected during the summer. It is concluded that there is probably only one generation per year. This is the first record of *Symbiocladius* from Australia, and it is shown that this species is closely related to *S. wygodzinskyi* Roback from Argentina.

Introduction

Fontaine (1964) and Arvy and Peters (1973) have reviewed the literature on the larvae of Chironomidae that are found in association with mayfly nymphs. It appears that the only species which actually feed on the tissues of their hosts are members of the genus *Symbiocladius*, and most records are from the flattened nympths of the Heptageniidae of the Northern Hemisphere. There is, however, one record of larvae on a species of Leptophlebiidae from North America (Mayo 1969), and careful description of another type of larva from a flattened leptophlebiid from southern South America (Roback 1965). It may be noted here that flattened leptophlebiid nymphs replace the Heptageniidae in the Southern Hemisphere.

The larvae found by Mayo (1969) on nymphs of *Thraulodes* were identified as *Symbiocladius*, but it is clear from her description and figures that they differ considerably from the other described species. The larvae, for instance, seem not to be parasitic, they have well-formed head capsules and they retain eyespots, caudal bristles and anal gills. They seem, in fact, to be not unlike the phoretic genus *Plecoteracoluthus*, which occurs on perlid stoneflies (Steffan 1965) and Megaloptera (Hilsenhoff 1968).

The specimens from Argentina, on the other hand, are clearly parasitic and damaging to their hosts, which were tentatively identified as *Thraulodes*. It was intriguing therefore, especially in view of the similarity of the biotas of southern South America and Australia, to find a very close relative on nymphs of the leptophlebiid *Atalophlebioides* in streams on the Great Dividing Range in Victoria.

THE MATERIAL

The specimens were obtained during monthly collections (June 1971 to June 1972) of the fauna of several streams that were used in the study of the life histories of stoneflies. The methods used are described by Hynes and Hynes (1975), where more information on the streams is given. Mayfly nymphs carrying larvae or pupae of Chironomidae were found in only three of the 11 stream stations that were intensively studied.

These were:

Crown Creek above Woods Point (map reference 424367), 2300 ft, a cool (max. 16¼°C), swift stream 5-10 m wide and up to 40 cm deep, with a stable bed of rocks and shingle.

Godfreys Creek below Frenchman's Gap (421374), 2500 ft, a cool (max. 13¾°C), fairly swift shallow stream 2-3 m wide, with a stable stony and gravelly bed containing some silt.

Delatite River below Sawmill Settlement (434423), 1900 ft, a cool (max. 16¾°C), swift, turbulent river about 15 m wide and up to at least 1 m deep, with a stable bed of boulders, stones and coarse sand.

No specimens of *Atalophlebioides*, which is a common genus in stony streams, were seen with chironomid larvae in any of the many other streams that we visited in Victoria. How-

ever, one pupa was taken, and unfortunately lost in an attempt to breed it out, in Leatherbarrel Creek, N.S.W. (615491) on January 8, 1974.

Two larvae were first noticed in the collection made on October 26, 1971, in Delatite River, one was found on November 24 in Crown Creek, and several were found in Godfreys Creek on December 28. They persisted in small numbers until February and March in the two creeks; in December there were many pupae, and in January and February only pupae (one pre-pupa in March) were obtained. In Delatite River only pupae were found on December 28 and no specimens were collected on or after January 25. These findings possibly indicate only a single generation per season for the chironomid. It seems that at least some species of the host mayfly, which is present at all times, are univoltine (Duncan 1972). Thirty-seven larvae and pupae were collected in total, 20 from Godfreys Creek and 12 from Delatite River, and four mayflies carried empty shrouds from which, presumably, pupae had emerged.

The Hosts

The host mayflies appear to be all of the same species of *Atalophlebioides* (Figure 1), which it is possible may later become specifically identifiable by its comb-like tarsal claws and by the peculiarly thickened distal margins of two of the segments near the bases of the three tails (Figures 1, C and D). No counts of uninfected specimens were made, but it is estimated that only about 1% carried the chironomid.

Infected nymphs are all middle-sized, 3½ to 6½ mm long, whereas fully developed nymphs were 8-8½ mm long. There was good evidence that the chironomid caused stunting rather than that smaller nymphs were selected for infestation. The larvae were attached laterally to the thorax, indifferently as to side: 18 out of 41 were on the right. When wing pads were present the one nearest to the parasite was always reduced (Figures 1, A and B) and the entire development of the nymph seems to have been retarded. For instance, the uninfected nymph of which the mesonotum is shown in Figure 1, F, was the same size and, as judged by the developing male eyes, in the same instar (probably the penultimate) as the specimen shown in Figure 1, B. Also, the most fully developed infected nymph, a 6½ mm male that still carried an empty pupal shroud, seemed to be physiologically near emergence in that its better developed wing pad enclosed a folded structure; but its wings were tiny and distorted (Figure 1, E) as compared with normal specimens in late instars (Figure 1, G and H). It may also be significant that the only chironomid collected on March 29 was a pre-pupa 1·75 mm long, which is shorter than the smallest formed pupa that was collected, and it was taken on one of the two smallest infected mayflies (3½ mm). It was also the only larva collected after the end of December. One may suppose that it infested a nymph that was too small or too unhealthy for ordinary development to occur.

The parasite larvae were completely enclosed in a tough membranous shroud, as has been described for other species of *Symbiocladius* (Codreanu, 1939; Roback, 1965), and they lay alongside the nota, sometimes with the tail tucked under the wing pad as shown in Figure 1, A. The larval head was directed forward or backward, apparently indifferently (13 out of 25 were forward), but I could find no trace of lesions on the nymphs. It seems clear, however, that, as with the European species (Codreanu, 1939), the host must supply the food.

The pupae were all attached as shown in Figure 1, B, with their heads over the mayfly abdomen, and it appears from the empty shrouds that they leave by a dorsal rip. There was no relationship between the sex of the host and that of the pupal parasites; all four possible combinations were found among the 12 pupae collected.

THE PARASITE

Six specimens, two larvae and four pupae, were used for the preparation of microscope slides for comparison with the clearly closely similar Argentinian species *S. wygodzinskyi* (Roback, 1965). The mountant was Euparal.

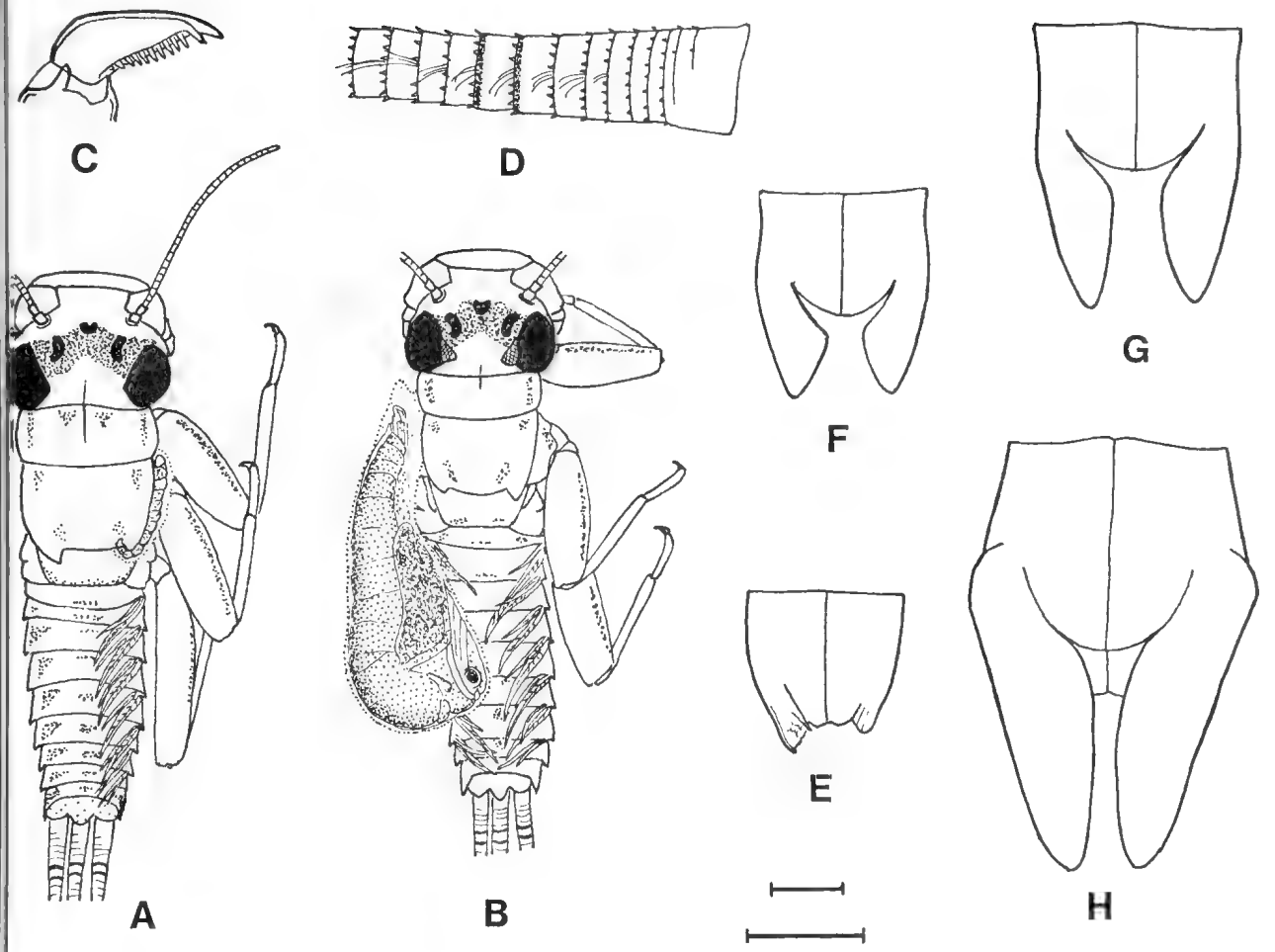

Fig. 1—A and B, Nymphs of *Atalophlebioides* with a larva and pupa of *Symbiocladius aurifodinae* (larger scale line 1 mm): C and D, claw and base of filum terminale of *Atalophlebioides* (upper scale line 0·1 mm): E-H, mesonota of *Atalophlebioides* (larger scale line 1 mm), E, an infected specimen 6½ mm long, F-H, uninfected specimens 6½, 7½ and 8¼ mm long. H, from Delatite River December 28, 1971, E, Godfreys Cr. February 25, 1972, rest from Godfreys Cr. December 28, 1971.

Genus SYMBIOCLADIUS Kieffer
Subgenus ACLETIUS Roback

1965 *Entomol. News* 76: 114-115.

The Australian material agrees in most respects with Roback's definition of *Acletius*. These include the haired eyes of the adult (Figure 2, E and H), the subequal tibial spurs (Figure 2, D), the long pectinate empodium, the three long basal spines on the claws (Figure 2, G), the latero-dorsal position of the larvae on the host (Figure 1, A), the five lateral teeth on the labial plate (Figure 3, B and E) and the two teeth on the mandibles (Figure 3, C).

There are, however, small differences. The antennae of the female have seven segments, rather than six (Figure 2, H), and the two mandibular teeth of the larva are subequal rather than being one robust and one accessory (Figure 3, C). I was unable to observe the palpal segments of the adult.

Symbiocladius (Acletius) aurifodinae sp. nov.

Male described from pupal material; 2·2 mm. Head and thorax dark brown, abdomen

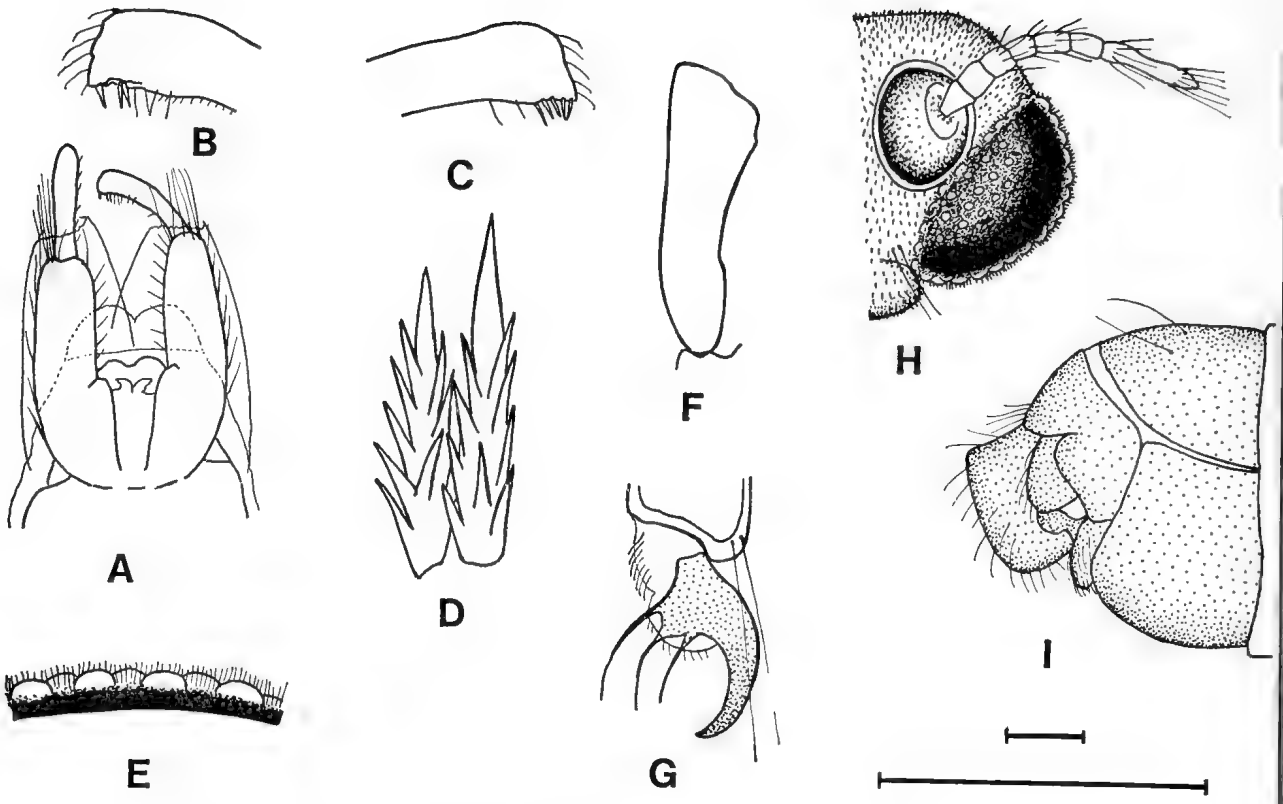

Fig. 2—*Symbiocladius aurifodinae*. A and B, D-G, holotype, H and I, allotype. A, genitalia and part of pupal skin (smaller scale line 0·1 mm): B, tip of dististyle (larger scale 0·1 mm): C, ditto of specimen from Godfreys Cr. December 28, 1971: D, tibial spurs of hind leg (smaller scale line 0·1 mm): E, optical section of eye margin (larger scale line 0·1 mm): F, pupal thoracic respiratory organ (smaller scale line 0·1 mm): G, claw of hind leg (smaller scale line 0·01 mm): H and I, head and abdominal tip of female (smaller scale line 0·1 mm).

brown with paler patches at bases of hairs. Antennae with at least 14 segments; eyes hairy, the hairs about as long as the diameter of the facets (Figure 2, E). Thorax apparently with bristles only on scutellum. Pronotum narrow and collar-like. Legs with subequal tibial spurs and with claws with three basal hairs (Figure 2, D and G); segment ratios as in Table 1. Genitalia as Figure 2, A and B, but note that the number of bristles at the tip of the dististyle is three in the type and five in the other specimen (Figure 2, C).

TABLE 1

Symbiocladius aurifodinae ratios of leg segments of type specimens (100 = 0·7 mm)

	femur	tibia	tarsal segments 1	2	3	4	5
Male							
fore	100	200	130	88	49	16	17
mid	99	146	131	34	27	16	15
hind	134	163	108	60	33	21	21
Female							
fore	161	225	171	64	37	29	29

Female described from pupal material; 3·1 mm. Similar to male, and also to *S. wygodzinskyi* Roback (Figure 2, H and I). It has, however, seven antennal segments, no ventral hair on the antennal pedicel, and it lacks the paler spots at the bases of the abdominal hairs.

Pupa, length, male 2·2 to 2·8 mm (holotype 2·2), female 2·3 to 3·8 (allotype 3·1); small respiratory trumpets present (Figure 2,

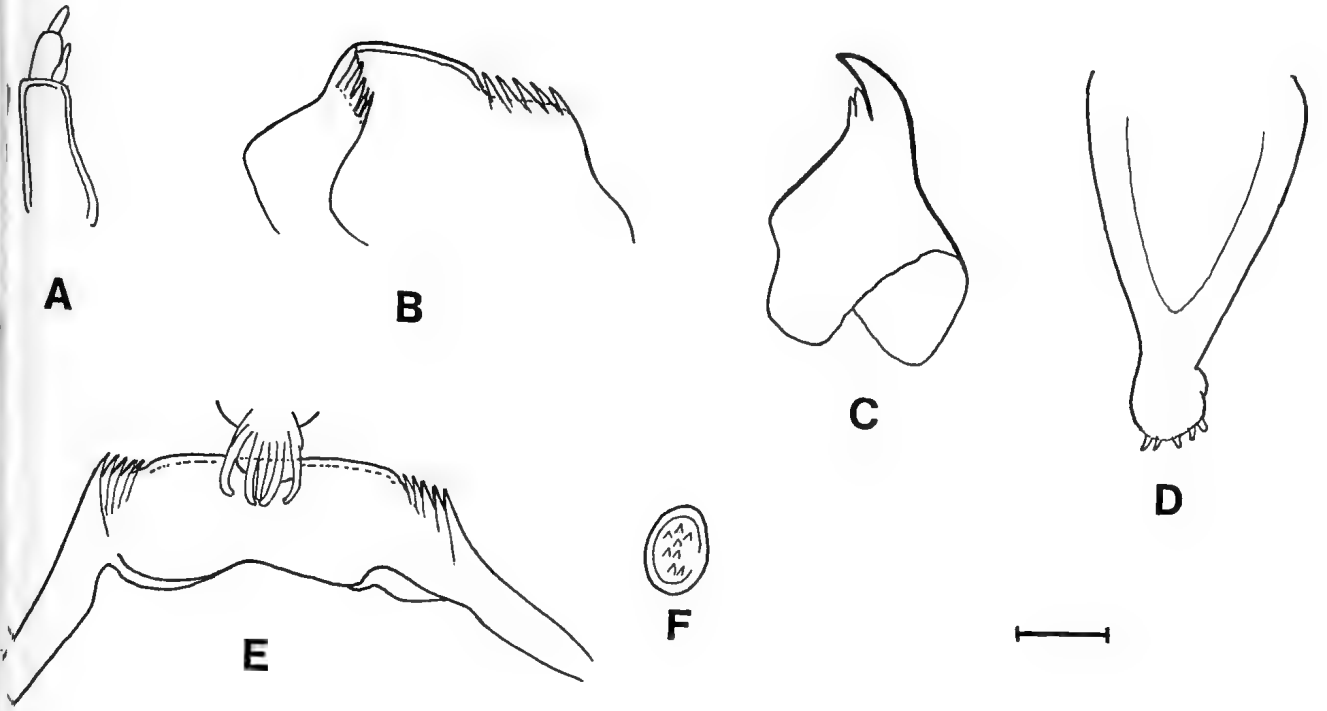

Fig. 3—*Symbiocladius aurifodinae*, larval appendages (scale line 0·01 mm): A, antenna: B, labial plate: C. mandible: D, Labrum: E, labial plate and tip of labrum: F, maxillary palp: A-D, head capsule of holotype: E and F, head capsule from a female pupa from Delatite R. December 28, 1971.

F). Cuticle thin and pale brown, without spines. In the male a small featureless tail fin (Figure 2, A); genital sacs elongate (Figure 2, A, where the tips of the sacs are missing). Note that Roback (1965) states that in *S. wygodzinskyi* the anal fins are twice the length of the genital sacs, but this does not agree with his figure. In mature female pupae, in which the abdomen is distended with eggs, the anal fin is hardly apparent.

Larva, the larvae range in length from 0·5 to 2·1 mm (two that are certainly last instar, with developing appendages, are 2·0 and 2·1 mm). Head pale yellow with a darkened hind edge; capsule widely open behind, almost a hemisphere. No eyespots. Body light brown with well formed anterior prolegs and small posterior ones; no posterior hairs or gills. Antennae small and little sclerotized; number of segments uncertain (Figure 3, A). Labial plate broad with five lightly sclerotized teeth on each side (Figures 3, B and E). Maxilla shows only a small lightly sclerotized ring with several central conical structures (Figure 3, F). Mandibles conspicuous hooks with two accessory teeth (Figure 3, C). Labrum with an apical swelling bearing about five lightly sclerotized teeth (Figures 3, D and E).

MATERIAL EXAMINED

Descriptions made mostly from the six mounted specimens.

Holotype —mature male pupa, Crown Cr., Jan. 27, 1972.

Allotype —mature female pupa, Godfreys Cr., Jan. 27, 1972.

Paratypes—male pupa and 2 last instar larvae, same data as allotype.

—head capsule of larva extracted from case of female pupa, Delatite R., Dec. 28, 1971.

Other Material

—2 larvae, 1 prepupa, 1 female pupa, Crown Cr., Nov. 24 and Dec. 28, 1971, and March 29, 1972.

—11 larvae, 2 male pupae, 2 female pupae, Godfreys Cr., Dec. 28, 1971, and Feb. 25, 1972.

—9 larvae, 3 female pupae, Delatite R., Oct. 26, Nov. 23 and Dec. 28, 1971.

All the specimens were collected by H. B. N. and M. E. Hynes. The types, paratypes and much of the other material has been presented to the National Museum of Victoria in Melbourne. Two larvae and one pupa from Delatite R., and four larvae and two pupae from Godfreys Cr. remain in the author's collection. The species is named for the goldmines which are still active around Woods Point near to which most of the specimens were collected.

Although in the absence of fully developed specimens, it is difficult to be certain, adults would probably run down to the genus *Crictopus* in Freeman's (1961) key to the Australian Orthocladiinae. The larvae and pupae are, however, very different from those of *Cricotopus*. They are also quite distinct from those of *Trissocladius*, with which the genus *Symbiocladius* has sometimes been combined, as was already pointed out by Saether (1969).

S. aurifodinae is clearly very closely related to *S. wygodzinskyi*, but there are a few differences. The male has more antennal flagellar segments, at least 14 as opposed to 13, and the bristles at the dististyle tip are pointed not ovate. The female has one more antennal segment. The pupa lacks dorsal spines and possesses a small respiratory organ. The larva has, apparently, much less robust lateral labial teeth and a wider central part to the labial plate, and its second mandibular tooth is larger. Also the tip of the labium which carries the spines is more swollen, and there seem to be no lateral spines below it such as are figured for *S. wygodzinskyi* by Roback. These seem to be very small changes after what must be many tens of millions of years of isolation of the two continents.

Acknowledgements

I have previously acknowledged the help from many people and organizations that allowed me so rewarding a sabbatical year in Australia. My principal benefactors were the University of Waterloo, Monash University, and the National Research Council of Canada. I remain in their debt.

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THE ASCIDIAN FAUNA OF WESTERN PORT, VICTORIA, AND A COMPARISON WITH THAT OF PORT PHILLIP BAY

By Patricia Kott
Queensland Museum

Abstract

The taxonomy of 59 species of ascidians from Western Port and Port Phillip Bay, Victoria, is discussed. The ascidian fauna of Western Port is markedly more diverse than that of Port Phillip Bay. The biogeographical affinities of the species are assessed and the implications of the differences in species composition in the two areas are investigated.

Introduction

A previous collection of ascidians from Port Phillip Bay has been reported on by Millar (1966) but prior to that no major work has been devoted to the ascidian fauna of Victoria. The greater part of the present material has been collected for the National Museum of Victoria by the Underwater Research Group (Western Port Survey). Additional records of species occurring in Western Port, available from independent collections made by Mrs. J. Watson and Mr. K. Duke on parts of the adjacent Victorian coast, from Mallacoota near the Victorian—N.S.W. border to Portland Harbour and Cape Nelson, have been included in the present work.

These collections are of particular interest in relation to the fauna of St. Vincent Gulf where large collections have recently been made and reported on (see Kott, 1972 a, b). Information on the better known fauna of Port Jackson and Moreton Bay to the north is also available. (Kott, 1952; 1957; 1962; 1963; 1972 c, d). These locations are all large embayments in the Australian coastline, essentially marine, and tidal. They are, however, all protected from the direct swell of the southern ocean, and receive some fresh-water runoff from the water-ways emptying into them and from the shores surrounding them.

The distribution of this sessile ascidian fauna is limited by the short free-swimming life of the pelagic larvae. Consequently species adapted to protected localities could be restricted in their distribution by lack of suitable sites for settlement on the open coast. The phylogenetic relationships of the ascidian fauna of each of these sheltered embayments are therefore of special zoogeographic and ecological interest in view of the likelihood of isolation of endemic and relict species.

There are 59 species in the collections, of which one, *Ciona intestinalis* is probably introduced. These species, are set out in Tables 1 and 2 together with others previously recorded from Port Phillip Bay and Western Port but not represented in these collection. Aspects concerning the biogeography and habitat of the ascidian fauna of these locations is discussed below.

Species List

APLOUSOBRANCHIA
CIONIDAE
Ciona intestinalis
CLAVELINIDAE
Clavelininae
Oxycorynia pseudobaudinensis n. sp.
Podoclavella cylindrica
Holozoinae
Atapozoa mirabilis
Sycozoa pedunculata
Sycozoa cerebriformis
POLYCITORIDAE
Eudistoma pyriforme
POLYCLINIDAE
Euherdmaniinae
Pseudodistoma cereum
Dumus areniferus
Polyclininae
Polyclinum marsupiale
Aplidium depressum
Aplidium lobatum
Aplidium triggiensis

Synoicum hypurgon
Synoicum sp.?
Sidneyoides tamaramae
DIDEMNIDAE
Tridemnum cerebriforme
Tridemnum cyclops
Didemnum candidum
Didemnum spongioides
Didemnum skeati
Didemnum moseleyi
Didemnum patulum
Didemnum turritum
Didemnum augusti
Didemnum roberti
Didemnum lambitum
Lissoclinum fragile
Lissoclinum ostrearium
Diplosoma translucida
Diplosma rayneri
Polysyncraton orbiculum
Polysyncraton victoriensis n. sp.
PHLEBOBRANCHIA
ASCIDIIDAE
ASCIDIINAE
Phallusia depressiuscula
Ascidia sydneyensis
Ascidia gemmata
STOLIDOBRANCHIA
STYELIDAE
BOTRYLLINAE
Botrylloides leachii
Botrylloides nigrum
POLYZOINAE
Symplegma viride
Amphicarpa diptycha
Polyandrocarpa lapidosa
STYELINAE
Polycarpa thelypanes
Cnemidocarpa etheridgii
PYURIDAE
Pyura australis
Pyura cataphracta
Pyura irregularis
Pyura albanyensis
Pyura lepidoderma
Pyura scoresbiensis
Pyura stolonifera praeputialis
Halocynthia hispida
Herdmania momus
Microcosmus australis
Microcosmus nichollsi
Microcosmus helleri
Microcosmus stolonifera
Microcosmus squamiger
MOLGULIDAE
Molgula mollis
Molgula sabulosa

SYSTEMATICS

Ciona intestinalis Linnaeus

Ciona intestinalis Linneaus, 1767, p. 1087. Kott, 1952, p. 319 for synonymy and description.

New Records: Port Phillip Bay (Oil wharf, Yarra River; artificial reef).

Distribution: See Kott, 1952.

Remarks: Kott (1969) has suggested that the cosmopolitan occurrence of this species, which is recorded from harbours and wharf piles in all regions outside the Antartic, is due to its transport on ships' hulls.

Oxycotynia pseudobaudiensis sp. nov.

(Fig. 1)

Clavelina baudinensis Kott, 1957, p. 87 (part: specimen with larger larvae) ?Millar, 1966, p. 363. Kott, 1972a, p. 4.

Type Locality: Laverton Bay (Victoria)

Holotype: Australian Museum A.M. Y1113.

Paratypes: W. Aust. Rottnest I., AM Y1112 (Kott 1957). S. Aust.: Carickalinga Head, South Australian Museum S.A.M. E876; Rapid Head S.A.M. E 877 (Kott 1972a). Vict. (Western Port): Balnarring Beach, A.M. Y1122 (Kott 1957); Crawfish Rock; Flinders Jetty, N.M.V. (new records).

Description: The colonies are 5-8 cm high and the wider terminal part of the head is 2 cm in diameter terminally. In the upper half of the colonies the test is delicate and sometimes glassy and transparent and encloses the body of the zooids which are never separate. On the upper surface the test forms only slight rounded protruberances over the anterior aspect of the zooids. In some colonies the zooid bearing upper part may be subdivided into several lobes. The slightly bulbous stalk narrows toward the base and is only slightly longer than half the height of the colony. The test of the stalk is firm and opaque and sometimes slightly leathery externally.

Zooids are from six to eight mm. In preservative they are a bluish colour and have dark accumulations of pigment in the mid line dorsal and ventral to the branchial siphon. There are 12 to 20 longitudinal muscles on the thorax and, depending on their degree of coalescence, they may vary in number on each side of the body. From six to eight of the most ventral bands are aligned at a slight angle with the longitudinal axis of the body and break up into branches over the anterior half of the endostyle. Of the remaining longitudinal muscle bands more than half extend into the branchial siphon and the others into the atrial siphon. Posteriorly the bands extend along both sides of the abdomen. There are from 16 to 20 rows each of 20 to 30 rectangular stigmata with a well developed transverse membrane between each row. In the mid dorsal line this membrane is expanded into the usual triangular, pointed languets.

The gut forms a simple and fairly short loop (seldom longer than the thorax), enclosing the gonads. The anus opens at the base of the peribranchial cavity and is bordered with minute rounded lobes. The stomach has no true structural folds. It is present in the middle to posterior one third of the abdomen. There is no prestomach.

Larvae are present only in the colonies from Rottnest Island and Laverton Bay (see Kott, 1957: larger larvae). They are large, 0·9 mm long with the tail wound threequarters of the way around the body. Triradiate papillae are supported around a flattened frontal plate. The adhesive cells rise in a cone from the centre of a depressed area which forms a fairly primitive papillary sucker or cup. The embryos appear to start their development in the proximal part of the oviduct and complete it in the right side of the peribranchial cavity where they demonstrate a wide range in stages of development. The most mature embryos are present anteriorly.

Remarks: The separate identity of the present species was first suggested by the different larvae present in colonies from Rottnest and Victoria which had all been assigned to the species *C. baudinensis* Kott, 1952. Most of the previously described specimens of that species excepting only those recorded by Millar (1966) have been re-examined.

Clavelina baudinensis from Cape Vlamingh, Rottnest Island and from Laverton Bay have small larvae (0·5 mm) in which the simple papillae without accessory suckers are supported around the anterior end of the body which is not separated into a frontal plate. In these larvae the tail completely circles the body. These colonies can be distinguished from the present species mainly by their longer, narrow and cylindrical stalk. The anterior extremity of the zooids project more from the anterior surface of the test than in *O. pseudobaudinensis*. Zooids of *C. baudinensis* examined have a maximum of 12 longitudinal thoracic muscles of which only a single band subdivides across the mid-line, ventral to the branchial aperture. In *C. baudinensis* there appears to be a more restricted range in the stage of development of embryos in the peribranchial cavity. Although some eggs are present in the oviduct they do not appear to start their development there as in the genus *Pycnoclavella*. In its colony and zooid form, *C. baudinensis* does appear to be closely related to *O. pseudobaudinensis;* however, its larvae and the degree to which eggs are apparently fertilised in the atrial cavity suggest that it is a more primitive species.

In *O. pseudobaudinensis* the oblique arrangement of the ventral thoracic muscles effects a depression of the anterior part of the thorax and draws it towards the postero-dorsal part of the thorax. The atrial aperture simultaneously becomes terminal as in *P. cylindrica*, thus facilitating the liberation of large larvae. In *C. baudinensis* larvae are smaller and more easily liberated through the normally oriented aperture; and the more parallel arrangement of longitudinal thoracic muscles does not appear to affect the relative position of the siphons. In neither of these species is the whole ventral surface withdrawn toward the postero-dorsal part of the thorax as is the case in *Podoclavella cylindrica* where there is a special brood pouch ensuring the retention of embryos.

Podoclavella cylindrica (Quoy and Gaimard)

Polyclinum cylindrica Quoy and Gaimard, 1834, p. 618.
Podoclavella cylindrica; Kott, 1972a, p. 5 and synonymy; 1972b, p. 167.

New Records: Western Port (Flinders Jetty, Balnarring Beach). Ram Head (18 mls south of Mallacoota Inlet, 6 m).

Distribution: W. Aust.: Rottnest Island, Fremantle, Albany; S. Aust.: St. Vincent Gulf, West Island, Wright Island; Vict.: Bass Strait, Port Phillip Bay. The greatest recorded depth for the species is 22 metres (West Island, Kott, 1972). The species is known from sheltered caves and under ledges.

Description: The present colonies generally have a firm basal common stalk and zooids are supported in the less firm terminal test and are independent of one another anteriorly. The usual blue pigment spots are present anteriorly and thoracic musculature extends obliquely from the ventral border to the postero-dorsal aspect of the body. Only in specimens from Western Port Bay are the zooids arranged around a central stalk which is 24 cm long and 2-4 cm in diameter, thickest terminally where it breaks into branches. Larvae of the usual form without ampullary lobes, are present in the brood pouches of this colony.

Remarks: In *P. cylindrica* contraction of the oblique thoracic musculature causes the foreshortening of the dorsal length of the thorax by drawing the postero-dorsal corner ventrally and anteriorly. The branchial aperture is simultaneously withdrawn leaving the atrial aperture terminal and anal and gonadial openings adjacent to it. The developing embryos are retained however, in a pouch from the dorsal surface, thus avoiding early liberation which could otherwise result from contraction of the thorax.

The relationship of specimens in which there is a central stalk to those that are supported upright and parallel to one another on a basal membrane is not known. Another specimen of the former type in the collection of the National Museum of Victoria is 60 cm long and resembles *Distaplia cylindrica* from the Antarctic (see Kott, 1969). The zooids in both forms are similar in every respect and the colonies appear to represent the same species. It is possible that the long axial stemmed forms are from deeper water.

Atapazoa mirabilis Kott

(Fig. 2)

Atapazoa mirabilis Kott, 1972b, p. 168.

New Records: Western Port (Tankerton jetty)

Distribution: The species has previously been recorded from S. Aust. (Elliston Bay).

Description: A single colony only is available. It is massive and irregular, 14 cm long and 6 cm wide. It is composed of fairly thin layers of zooid bearing test that coalesce so that the colony is traversed by spaces. The atrial siphon from the postero-dorsal corner of the thorax is characteristically long and posteriorly directed. Both the branchial and atrial apertures are bordered by six distinct lobes. There are three rows each of about 12 stigmata in each row. The horizontal gut-loop consists of a fairly long oesophagus, rounded stomach and wide intestinal loop. There is a single large ovum attached to the zooid from a region in the loop of the gut. The position of the brood pouch is apparently abdominal, rather than thoracic, and is reminescent of the situation in the Didemnidae.

Remarks: The species has been recorded previously only from Elliston Bay in South Australia. It is possible that it is endemic to the southern coast although the type location, on the floor of a cave, is only accessible to collectors equipped with SCUBA.

Sycozoa pedunculata (Quoy and Gaimard)

Aplidie pedunculatum Quoy and Gaimard, 1834, p. 626.
Sycozoa penduculata; Kott, 1972c, p. 234 and synonymy.

New Records: Western Port (Rutherford Channel); Port Phillip Bay (no location, artificial reef). South-east Portland.

Distribution: W. Aust.: Cockburn Sound, King Georges Sound; Tas.: d'Entrecastaeux Channel, Derwent Estuary, Furneaux Group; S. Aust.: St. Vincent Gulf; Vict.: Western Port,

Port Phillip Bay, Lakes Entrance; Qd.: Moreton Bay.

Discription: The usual large inverted conical heads on long slender stalks with basal tufts of roots. There are deep V-shaped furrows between each double row of zooids and the branchial apertures from each row of zooids open into each side wall of these furrows. The branchial openings are thus protected to some extent and the furrow provides an immediate microenvironment outside the openings. The apex of a rounded ridge between two of these furrows lies over the common cloacal canal. There are very large common cloacal openings around the outside of the flattened free ends of the lobes.

Larvae are present in colonies from Southeast Portland. They have the usual anterior papillae, an otolith, but no ocellus, and a short broad tail extending only three quarters of the ways around the body of the larva.

Sycozoa cerebriformis (Quoy and Gaimard)

Aplidie cerebriforma Quoy and Gaimard, 1834, p. 625.

Sycozoa cerebriformis; Kott, 1972a, p. 8 and synonymy.

New Records: Western Port (Crawfish Rock, Tankerton Jetty). Portland Harbour (5-10 m on rocks forming jetty).

Distribution: N.W. Aust.; S. Aust.: St. Vincent Gulf; Vict.: Balnarring Beach (Western Port), Port Phillip Bay; N.S.W.: Jervis Bay, Port Stephens, Port Hacking, Port Jackson. South Africa. It has been recorded from 5-40 m.

Description: Specimens are sturdy fan-shaped colonies with short stalks. The fan or zooid bearing portion may extend into a thick undulating lamellae. Common cloacal apertures are present along either side of the flattened free edge of the lamella. The double rows of zooids converge from this outer edge of the lamella down toward the top of the stalk.

Remarks: The specimens from deeper water at Crawfish Rock are larger than the colony taken in shallower water. It has already been observed (Kott, 1972a) that the species favours areas where there are steady but not strong unidirectional currents, and no surge or turbulence. The fan-like colony shape is apparently adapted to take maximum advantage of this type of environment. This species appears to be confined to more sheltered locations than *S. pedunculata,* very often where there is some turbidity and a muddy substrate although in the absence of a larval ocellus the light conditions are not likely to affect its settlement.

It has been recorded from a wider circumpolar range than *S. pedunculata* but although it has been taken from north western Australia it is not recorded from Moreton Bay and it has not been recorded from Tasmania. Its latitudinal range is therefore more limited. It has not been taken from depths greater than 40 metres. Its distribution suggests that it may represent a relict species confined within embayments in relatively shallow water where it can best take advantage of sheltered conditions.

Polycitor giganteum (Herdman)

Polyclinum giganteum Herdman, 1899, p. 79.

Polycitor giganteum; Kott, 1972a, p. 9 and synonymy.

New Records: Western Port (Crawfish Rock, Tankerton Jetty). Ram Head (18 mls south of Mallacoota Inlet, 6 m).

Distribution: A wide circum-Australian distribution from Rottnest Island (W.A.) and across the southern coast to Port Jackson (N. S. W.).

Description: One specimen from Crawfish Rock is more or less flattened and sessile, about 13 cm in diameter but only 5 cm high; another specimen has the usual rounded gelatinous head narrowing to a waist before expanding into a wide sandy base, possibly embedded in the substrate. The test is characteristically transparent and gelatinous and the zooids are large, radiating out from the base of the colony to open by separate apertures around the head.

Remarks: The species appears to favour rocky substrates where a firm adhesion can be effected, thus satisfying the requirements of a large, inflexible colony that is fixed by only a small area of the base. The species is found equally in embayments and on the open coast.

Eudistoma pyriforme (Herdman)

(Fig. 3)

Psammaplidium pyriforme Herdman, 1886, p. 419.
Eudistoma pyriforme; Kott, 1972a, p. 9 and synonymy.

New Records: Western Port (Crawfish Rock). Ram Head (18 mls. south of Mallacoota Inlet, 6 m).

Distribution: Palao and Gilbert Islands. Qd.: The Great Barrier Reef, in the Pacific; S. Aust.: St. Vincent Gulf. Madagascar.

Description: The colony from Mallacoota Inlet is flattened and firm with sand absent only from the surface layer of test which has brownish-purple spherical pigment cells. The colony from Crawfish Rock is irregular and investing, with a dense sand inclusion throughout the test, making it rather hard and obscuring the arrangement of the zooids. There are about 10 fairly wide muscle bands down either side of the thorax and an almost continous layer of circular muscles. The circular muscles on the siphons are well developed but do not form definite sphincters. The oesophagus is of medium length opening into a large shield shaped and smooth stomach halfway down the abdomen; the duodenal area is long, and in a contracted abdomen is bent in an S-shape. The intestine bends anteriorly after leaving a spherical posterior stomach, and forms a loop opposite the duodenum when the abdomen is contracted. The rectum extends anteriorly, to the peribranchial cavity, and is straight.

Remarks: Although Hastings (1931) regarded the loop in the gut as diagnostic of this species it has been observed in other species where the abdomen is contracted. There are few reliable diagnostic characters available in this genus where colony shape is variable, no systems are formed, and where the strong body musculature results in highly contractile zooids. The development of the musculature, the length of the oesophagus and the nature of the common test, therefore, provide the only morphological characters to determine the species, and it is possible that some misidentification occasionally occurs. The recorded distribution of this species also suggests that more than a single species is represented.

Pseudodistoma cereum Michaelsen

Pseudodistoma cereum Michaelsen, 1924, p. 364. Kott, 1972a, p. 12 and synonymy.

New Records: Western Port (Crawfish Rock). Cape Nelson (near Portland, vertical faces and roof of cave, moderate surge, 5 m).

Distribution: The species is apparently common intertidally and from depths down to 70 metres off the South Island of New Zealand. Other records are from the eastern coast of Victoria, and off the South Australian coast and from Dakar.

Description: The colony is very damaged and its form is not discernible. The test is very soft, jelly-like and transparent. Both apertures are 6-lobed, there are 3 rows each of about 20 stigmata. Stomach folds are not apparent externally, however internally its glandular wall is interrupted in 4 places to give, the appearance of folds. The zooids are short and the thorax, abdomen and posterior abdomen are of equal length.

Remarks: Zooids are characteristic. In view of the Australian and New Zealand records suggesting a circum-polar distribution in the southern cold temperate region the record from Dakar (Monniot, 1969) is surprising. Monniot's specimens do, however, agree with the present colonies and with those from New Zealand. The species is delicate and is taken from underneath ledges and in rocky locations where some protection is available.

Dumus areniferus Brewin

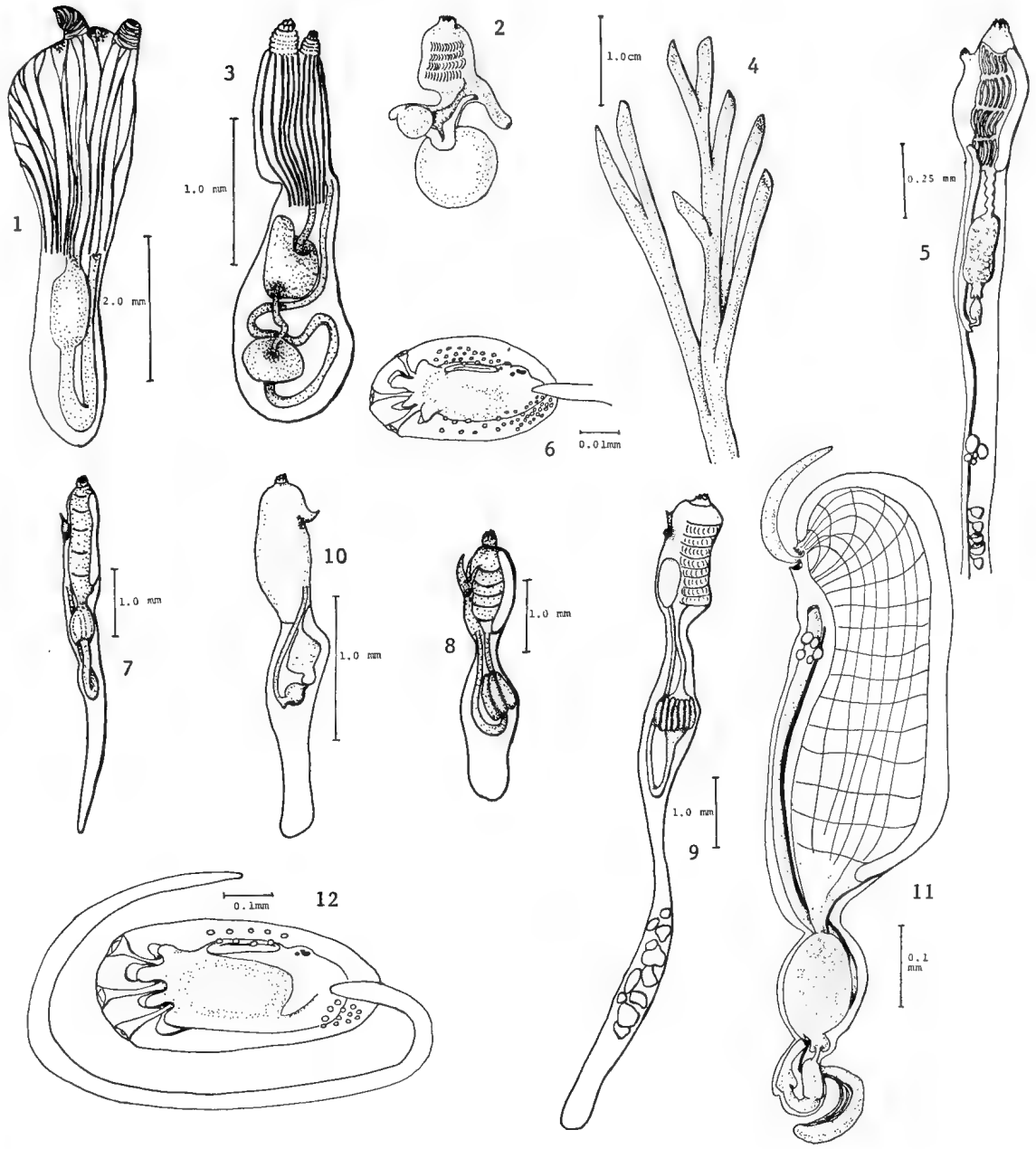
(Figs. 4, 5, 6)

Dumus areniferus Brewin, 1952, p. 453.

New Records: Western Port Bay (Crawfish Rock).

Distribution: New Zealand: Otago.

Description: The colonies form a thicket of elongate branching stalks, club-shaped terminally with the free end obliquely flattened. The outer test is encrusted with a single layer of sand particles giving rigidity to the otherwise extremely delicate test. Each terminal lobe contains only a single zooid. The maximum length



Oxycorynia pseudobaudinensis
1—contracted zooid, musculature not shown on abdomen.
Eudistoma pyriforme
2—contracted zooid, musculature not shown on abdomen.
Atapozoa mirabilis
3—zooid.
Dumus areniferus
4—colony. 5—zooid. 6—larva.

Aplidium depressum
7—zooid.
Aplidium lobatum
8—zooid.
Aplidium triggiensis
9—zooid.
Synoicum hypurgon
10—zooid
Sidenioides tamaramae
11—zooid. 12—larva.

of the stalks is 6·0 cm. Zooids are about 3 cm long, of which the long thread-like posterior abdomen is about two-thirds of the total length. Both apertures are 6-lobed and open directly onto the surface of the terminal flat surface of the stalks. There are no protective flaps of test protecting the apertures such as are found in *Euherdmania australis*. There are about eight very fine thoracic muscles along each side of the thorax. There are six long stigmata crossed by parastigmatic vessels in each of four rows. The abdomen is approximately the same length as the thorax. The oesophagus is of moderate length, the smooth walled stomach is elongate and there is a posterior stomach and a duodenal region. A mid-intestinal region occupies, with the stomach and oesophagus, the descending limb of the gut loop before it enters the rectum in the pole of the loop. Testis follicles are present in a single row in the posterior abdomen and there is a group of ova anterior to the testis lobes, a little distant from the posterior end of the abdomen. The gonads occupy only the posterior half of the posterior abdomen.

The larvae are 0·5 mm long and there may be up to nine in the peribranchial cavity. They have paired rows of ampullary vesicles dorsally along either side of the endostyle and along either side of the postero-ventral aspect of the larval body. There are the usual three papillae anteriorly and these alternate with median ampulllae. Lateral ampullae are also present either side of the median ampullae.

Remarks: The specimens conform exactly both in colony and zooid form with those described by Brewin from New Zealand. The species resembles both *Euherdmania australis* and *Ritterella herdmania,* both with a similar colony. Externally it is distinguished from *E. australis* by the absence of the flap of test which protects the external aperture in the latter species (see Kott, 1957, 1972b), and from *E. herdmania* by the fan shape of the terminal tip of each lobe. It is possible that the aberrant colonies mentioned by Kott (1957) that were taken with *E. australis* were actually specimens of the present species.

Polyclinum marsupiale Kott

Polyclinum marsupiale Kott, 1963, p. 83.

New Records: Western Port (Crawfish Rock).

Distribution: S. Aust.: Victor Harbour; Tas.: Hunter Island; Qld.: Great Barrier Reef (Heron Island).

Description: Colonies are mushroom-shaped, up to 2 inches in diameter across the upper surface of the head which is supported on a short stalk; or alternatively the colonies may be spherical and sessile, fixed by a small area of the base. There is a dense outer layer of sand on the test absent sometimes from parts of the upper surface. Internally the test is very soft with only very occasional sand grains included. The internal test is traversed by canals in which the zooids are contained, and forms only thin septa between these canals. Preserved colonies are therefore often collapsed and flattened.

The zooids, opening around the upper half of the colony, are very small. The branchial aperture is terminal. The antero-dorsal atrial aperture is on a short siphon with a circular sphincter muscle and the opening is protected by a pointed muscular languet from the body wall anterior to the siphon. There are 14 to 15 rows of 10 to 12 rectangular stigmata with the usual rounded papillae on the transverse vessels. The stomach is smooth externally with an inner glandular wall.

Remarks: The heads of living colonies are apparently distinctively spherical, although in preserved specimens the soft internal test collapses and they are flattened and sometimes appear lobed or folded.

Aplidium depressum Sluiter

(Fig. 7)

Aplidium depressum Sluiter, 1909, p. 102. Kott, 1963, p. 95 and synonymy.

New Records: Western Port (Crawfish Rock, Rutherford Channel)

Distribution: Previously recorded only from Bargara (Queensland) and from Indonesia and the Philippines. The species is common in those locations from which it has been recorded. The reason for these isolated records is not known.

Description: Soft, jelly-like, flat investing colonies that are minute and circular fixed by a small area of their base, or more extensive fixed by the whole extent of the basal surface. The species commonly invests stalks and fronds of weed. Only very sparse sand grains are enclosed in the semitransparent brownish common test through which the zooids are clearly evident. In the smaller colonies the zooids are arranged in two or three circular systems of about six zooids, but in the larger colonies these expand into double row systems.

The zooids are minute with an inconspicuous sessile atrial aperture halfway down the dorsal surface of the thorax. There is a single short, pointed atrial languet from the upper border of the aperture. There are five rows of about eight stigmata. The thorax and abdomen are of equal length and together represent half the length of the zooid. The stomach has 11 distinct folds.

Remarks: The small number of rows of stigmata, with the number of stomach folds, the form of the colony and the nature of the test distinguish the species.

Apldium lobatum Savigny

(Fig. 8)

Aplidium lobatum Savigny, 1816, p. 182. Kott, 1963, p. 97 and synonymy.

Non *Psammaplidium lobatum;* Herdman, 1899, p. 85 (<*Aplidium solidum* Herdman, 1899; Millar 1963; >*A. arboratum* Kott, 1963).

New Records: Western Port (Crawfish Rock).

Distribution: Florida, West Indies, the Mediterranean, Red Sea, Indonesia, Queensland and the Great Barrier Reef and New South Wales. The present record extends the southern range of this species from the east coast of Australia.

Description: The colonies are irregular and investing. The common test is firm and hard with sand throughout. Zooids are minute with the thorax, abdomen and posterior abdomen all of equal length. The sessile atrial aperture has a deeply divided trifid languet from the anterior border of the opening. There are 8 fine longitudinal muscle bands along each side of the thorax extending onto the abdomen and posterior abdomen. There are six rows each of about six stigmata. The four stomach folds are only apparent internally.

Remarks: The species appears to be adapted for a rigorous environment, and is found investing the undersurface of rocks and in the present case, in algal holdfasts. The firm test and zooids with few stomach folds, are similar to the condition found in *A. solidum* Herdman in which zooids open on both sides of flat lamellae.

Aplidium triggiensis Kott

(Fig. 9)

Aplidium triggiensis Kott, 1963, p. 104.

New Records: Western Port (Crawfish Rock).

Distribution: W. Aust.: Rottnest Island, Triggs Island and Nornalup; Vict.: Balnarring Beach.

Description: The colonies are very soft and investing stones, etc. Sometimes they are produced basally into projections which extend into or around the substrate to form a very firm adhesion. Varying quantities of sand are present in the colonies. Posterior abdomina cross one another in the basal test. The zooids are minute, the thorax is 1·3 mm long and generally shorter than the abdomen when contracted; the posterior abdomen is long and thin and up to twice the length of the rest of the body.

There is a sessile atrial aperture about one third of the distance down the dorsal surface of the thorax, with a short, pointed, undivided languet from the upper border of the opening. There are 9 to 10 rows of about 15 stigmata. The oesophagus is long and the stomach, present about half way down the abdomen, is broken up into 14 to 15 distinct folds. A single embryo is present in the peribranchial cavity. It is 0·6 mm long and anteriorly there is a multiplicity of adhesive papillae in the median line around the anterior end of the larva as previously described for this species (Kott, 1963).

Remarks: This species also appears to be adapted for very rigorous conditions, both by the form of the colony and its tendency to produce extensions to fix it firmly to the substrate. The larval form is quite distinctive and is large in relation to the size of the zooid.

Consequently, a maximum of two larvae have been reported as present in the peribranchial cavity. In the absence of this distinctive larval form, these species could be confused with *Aplidium multiplicatum* (Sluiter) which has been recorded from Queensland, Japan, the Philippines, Indonesia and from Broome, North-western Australia (see Millar, 1963). In the latter species, however, the posterior abdomen is relatively short and the testis lobes form bunches in the posterior abdomen, rather than double rows, as in *A. triggiensis*.

Aplidium pliciferum (Redikorzev)

Amaroucium pliciferum Redikorzev, 1927, p. 390. Kott, 1972a, p. 13 and synonymy.

New Record: Western Port (Tankerton Jetty).

Distribution: See Kott, 1972a.

Description: The colony is a firm gelatinous cushion with a flat upper surface. There is a short stalk from the middle of the under surface. The margin of the colony is rounded. The test is semi-transparent and there is neither encrusting nor included sand. The zooids are tightly packed in double rows radiating from common cloacal apertures randomly placed on the upper surface. Anteriorly the zooids are parallel to one another and vertical, although the posterior abdomina may be more irregularly orientated in the basal half of the test. There are 12 fine longitudinal thoracic muscles extending separately along the abdomen and both sides of the posterior abdomen. They are never gathered into a close band. The atrial aperture is sometimes produced into a short siphon and the pointed single bifid lip extends from the upper border of the aperture. There are 11—15 rows each of about eight stigmata. The thorax and abdomen are about the same length and the posterior abdomen is long and threadlike. The stomach has 18 to 20 regular longitudinal folds.

Larvae are present in the peribranchial cavity. They have a double row of ampullary vesicles from the lateral ridges on either side of the median papillae which alternate with median ampullae.

Remarks: Although there is some variation in the number of rows of stigmata, in the number of stomach folds and in the shape of the colony, the firm gelatinous flat-surfaced colony form varies only in relation to the area by which it is fixed. The larvae are also characteristic. The species differs from the closely related *A. flavolineatum* which has more thoracic muscles, more stomach folds, lateral branches on the larval median ampullae and no larval ampullary vesicles.

Synoicium hypurgon (Michaelsen)
(Fig. 10)

Macroclinum hypurgon Michaelsen, 1924, p. 401.
Synocium hypurgon; Kott, 1963, p. 86 and synonymy.

New Records: Western Port (Crawfish Rock).

Distribution: W. Aust.: Rottnest Island, Fremantle; Great Barrier Reef: Heron Island. New Zealand: North Island.

Description: The present specimen consists of three large clavate to mushroom shaped lobes joined basally and to varying extends along their sides to form a large, hemispherical colony, 5 cm in diameter and sessile basally. There is sand around the sides of each lobe but not on the upper surface where the zooids open. The test is soft and gelatinous and has no foreign bodies. The zooids are present in the outer layer of the upper surface. There is a small, sessile atrial aperture one third of the distance down the dorsal surface of the thorax with a large, triangular atrial languet rising from the body wall anterior to the aperture. There are eight longitudinal muscle bands on the thorax. The branchial sac is very long and narrow with 13 rows of eight small oval stigmata in each row. The gut loop is short, about half the length of the thorax. The oesophagus is especially short and the stomach small and smooth. There is a duodenal enlargement and a posterior stomach in the loop of the gut.

Remarks: Although there is considerable variation in the form of colonies of this species and some variation in the amount of sand and other material which is contained in the common test, the small zooids, long, narrow branchial sac and relatively short abdomen, together with the relative position of the atrial tongue from the body wall rather than from

the anterior border of the atrial aperture distinguish it.

Synoicium sp.?

Record: Western Port (Crawfish Rock).

Description: The specimen is damaged and torn, although the fragments appear to represent a fairly thin investing colony. The test is semi-transparent and very soft. Zooids appear to be arranged parallel to one another and vertical to the upper surface. Zooids are fairly small and the thorax and posterior abdomen are about equal in length, while the abdomen is shorter. There are about 10 longitudinal thoracic muscles. The atrial aperture is sessile and there is a single pointed languet from the upper margin of the opening. There are three rows of about 10 long rectangular stigmata, each row crossed by parastigmatic vessels. Dorsal languets are present in the mid-dorsal line opposite both transverse vessels and parastigmatic vessels. The stomach is shield-shaped and smooth without any areolations, although it has a glandular appearance.

Remarks: The parastigmatic vessels in the branchial sac are unusual, although they have previously been described for *Synoicium atopogaster* Kott, 1962. The small number of rows of stigmata in the branchial sac suggests a relationship with *Synoicium bowerbanki*, which has, however, a longer oesophagus and a distinct atrial siphon. Further, in the present specimen, the dorsal languets opposite the parastigmatic vessels as well as the primary transverse vessels suggests that the rows of stigmata are in the process of subdividing and in fact the most posterior row does contain a few stigmata which are bisected in the region of the parastigmatic vessel. *Synoicium papilliferum* differs from the present specimen in the presence of a long siphon, although it has a short oesophagus, as well as the same number of longitudinal muscles and about the same number of stigmata in each row, as does the present specimen. It is most probable, therefore, that this represents a juvenile of some species of *Synoicium*, rather than a new species characterised by 3 rows of stigmata crossed by parastigmatic vessels.

Sidneioides tamaramae Kesteven
(Figs. 11, 12)

Sidneioides tamaramae Kesteven, 1909, p. 277. Kott, 1957, p. 104.

New Records: Western Port (Crawfish Rock).

Distribution: N.S.W.: Tamaramae Bay.

Description: The colonies are soft and pillar-like lobes. The free end of each lobe is raised into a rounded marginal ridge surrounding a terminal depressed surface from the centre of which there is a protruberant common cloacal aperture. The branchial apertures are made conspicuous by the absence of sand, around them. They open onto rounded swellings on the marginal ridge. The external test is completely encrusted with sand, absent only from the region around the apertures. The test is otherwise very soft. The abdomen is about half the size of the long thorax. The atrial lip is narrow and fleshy but very long with about 10 fine muscles extending along its length. The longitudinal thoracic muscles extend along the ventral side of the abdomen and the dorsum of the posterior abdomen causing it to curve when the muscles are contracted. There are 17 rows of stigmata with 18 stigmata in each row. There is no sign of papillae on the transverse vessels. The stomach is oval with mulberry-like glandular swellings in its wall. There is a duodenal region, a posterior stomach and a mid-intestine which expands into the rectum before it curves into the ascending limb of the gut loop. The ovary is developed in the thoracic wall at about mid-thoracic level and projects into the peribranchial cavity just to the right of the mid-line, the vas deferens and the distal part of the rectum. The anal opening is opposite the 7th row of stigmata.

There are about 18 eggs at varying stages of development in the ovary. Free eggs are also present in the peribranchial cavity together with up to 20 developing embryos. Mature embryos are 0·6 mm long and the tail is wound completely around the body. There is a double row of vesicles along either side of the mid-dorsal line and a cluster of vesicles postero-ventrally on each side of the body. Paired lateral ampullae alternate with the three

anterior papillae but there are no median ampullae.

Remarks: This record has extended the range of this interesting species, previously regarded as endemic to a small region on the coast of New South Wales.

Tridemnum cyclops Michaelsen

(Fig. 13)

Tridemnum cyclops Michaelsen, 1921, p. 19. Kott, 1966, p. 286 and synonymy. Eldredge, 1967: 183.

New Records: Western Port (Flinders Jetty, Eagle Rock).

Distribution: West Indian Ocean. N. Aust.: Darwin, Great Barrier Reef.

Description: Both the present records represent extensive colonies, almost completely investing specimens of *Ascidia sydneyensis*. In both cases the branchial aperture is free, although in one specimen the didemnid has grown over the atrial siphon, leaving a small space between the test of the host through which the excurrent water could flow.

The surface of the colony is smooth with a superficial layer of flat bladder cells and some spherical purple pigment cells. The spicules are dense beneath the layer of bladder cells and in the thoracic region and become less dense toward the base of the colony where they are absent altogether. They are from 0·03—0·05 mm in diameter with up to 12 pointed rays in optical section. There are no zooxanthellae in the common cloacal system of these specimens. There is a very shallow thoracic common cloacal cavity. The zooids have a minute thorax with three rows of stigmata. There is no endostylar pigment cap present in these specimens. The retractor muscle is fairly long. There is no atrial siphon, although there is a well defined and fairly long anterior lip from the border of the aperture. There is a single undivided testis follicle with 8¼ coils of the vas deferens.

Remarks: The surface bladder cell layer, the shallow thoracic common cloacal canal, the absence of an atrial siphon and the form and distribution of the spicules are characteristic of this species. The extensive colonies are different to the typical small colonies of tropical specimens. The absence of zooxanthellae should be especially noted as these are invariably present in specimens previously described. It is possible that the zooxanthellae are associated with a tropical environment and should not be regarded as a specific character. In addition, the endostylar pigment cap has invariably been present in previously described specimens of this species, but it is possible that its presence is a variable character as in *T. cerebriforme* (see below). However, these specimens do diverge from the characteristic facies of this tropical species and it is possible that there is a cline in its characters that is evident at the southern limit of its range.

Tridemnum cerebriforme Hartmeyer

(Fig. 14)

Tridemnum cerebriforme Hartmeyer, 1913, p. 139. Kott, 1972d, p. 247; 1972e, p. 47 and synonymy. non *Tridemnum cebriforme*; Kott, 1972b, p. 178.

New Records: Western Port (Crawfish Rock).

Distribution: South and West Africa; Indian Ocean; S.W. Aust.; S. Aust.; Vict.: Phillip Island; N.S.W.; Qd.; Gulf of Carpentaria. It therefore has a wide distribution in the southern temperate to subtropical regions and is absent only from the eastern Pacific and the Western Atlantic.

Description: The colony is irregularly lobed. Branchial openings are conspicuous and slightly protruberant, owing to the density of spicules filling the branchial lobes. There is the usual posteriorly directed atrial siphon. There is an extensive posterior abdominal cloacal system formed by canals traversing a central core of test. The spicules are less dense than at the surface. They are large, from 0·04 to 0·07 mm in diameter with five conical rays in optical section. The endostylar pigment cap is absent.

Remarks: With the exception of the endostylar pigment cap the zooids and colony of this specimen are identical with those previously described. The pigment cap is also absent from the specimens of *T. cyclops* from this locality. Specimens from South Australia (Kott, 1972b) without a posteriorly directed atrial siphon are incorrectly assigned to this species.

?Didemnum candidum Savigny
(Figs. 15, 16)

Didemnum candidum Savigny, 1816, p. 194. Kott, 1972a, p. 19 and synonymy; 1972b, p. 179.

New Records: Western Port (Crawfish Rock).

Distribution: Cosmopolitan (see Kott, 1972a).

Discription: Flat small pinkish colonies, the colour being due to the fairly sparse distribution of spicules allowing the zooids to show through. Spicules are mostly in the surface and basal test. There is an extensive thoracic common cloacal system. Zooids are about one mm long with four rows of stigmata. The anterior border of the atrial aperture is produced into an atrial lip, forked terminally. There is a single testis follicle with 4¼ coils of the vas deferens. Spicules range from 0·02 to 0·05 mm in diameter with conical pointed to needle-like rays.

Remarks: The present young colonies have the spicules typical of this species together with the extensive thoracic common cloacal cavity. Zooids of more typical colonies are brown. The production of the anterior border of the atrial aperture into a lip is another character not usual for the species.

Didemnum moseleyi (Herdman)
(Fig. 17)

Leptoclinium moseleyi Herdman, 1886, p. 272.
Didemnum moselyeyi, Kott, 1972a, p. 19 and synonymy; 1972b, p. 179; 1972d, p. 249.

New Records: Western Port (Crawfish Rock, Eagle Rock).

Distribution: Pacific and Indo-Malayan region; circum-Australian.

Description: Common, although not very numerous. White investing colonies and small circular colonies on weed are available. Spicules are dense throughout the test which is rather brittle. The common cloacal canals are thoracic and zooids are enveloped in an independent thoracic sheath where the thorax crosses the common cloacal cavity. The surface layer of test is very thin indeed. In some colonies there are primary canals extending to abdominal level and surrounding discrete clumps of zooids which are embedded abdominally in the common basal test, although their thoraces are separate, each in a discrete thoracic sheath. The surface layer of test in these colonies is depressed over the deep primary cloacal canals giving a cauliflower appearance to the surface of the colony. Large common cloacal openings are distributed randomly over the surface and some spicule filled papillae are also present on parts of the colony. The spicules are 0·01 to 0·03 mm in diameter with about seven pointed rays in optical section. The common cloacal system in this species does not appear to develop by proliferation of double row systems but by a development of the primary cavity to envelop the thorax of each zooid as it is added to the system. Zooids are minute and colourless in formalin. Small spherical lateral organs are present either side of the thorax opposite the most posterior row of stigmata. There is a long retractor muscle. The vas deferens coils 9½ times around the undivided testis follicle.

In one specimen large spherical vesicular cells are present in the surface test surrounding each branchial opening to form wide intersecting circles that interrupt the dense spicules so that the surface appears to be pitted rather than smooth. The spicules, cloacal system and zooids otherwise conform with *D. moseleyi.*

Remarks: The vas deferns in these colonies has more coils than is usual for the species although a wide range has been reported. The distribution and form of the rather constant spicules and the size and position of the lateral organs have been used to determine this species and to distinguish it from *Didemnum candidum* (see Kott, 1972a) which has a similar cloacal system and a similarly wide range recorded for the spirals of the vas deferens.

Didemnum patulum (Herdman)
(Fig. 18)

Leptoclinum patulum Herdman, 1899, p. 92.
Didemnum patulum Kott, 1972a, p. 18.

New Records: Western Port (Crawfish Rock, on *Ecklonia* holdfasts and investing other ascidians; Eagle Rock).

Distribution: N.S.W.: Port Jackson; S. Aust.: St. Vincent Gulf.

Description: Colonies form large sheets. The surface is smooth. Smaller colonies may be an even, greyish colour, but larger colonies always have grey-blue to black mottled markings. There is a surface layer of bladder cells and beneath these numerous stellate pigment cells are distributed amongst the spicules to form the mottled markings that characterise the species. Spicules gradually become less dense toward the base of the colony. The pigment cells are especially concentrated in the test overlying the cloacal canal; occasionally they may extend into the test beneath the surface layer and beneath the common cloacal cavities and when this occurs the colony is almost black in colour. The spicules are stellate, with pointed or rounded rays. The majority of spicules are 0·03 - 0·04 mm in diameter with about seven rays in cross section. There are, however, less common spicules of similar form but larger diameter, up to 0·05 mm. There are also smaller spicules with up to 12 sharply pointed rays in cross-section similar to those found in *Didemnum candidum*.

The zooids are embedded in the rather solid common test and open on both sides of cloacal canals. Primary cloacal canals sometimes extend the whole length of the zooid and may extend slightly posterior abdominally. The secondary cloacal canals remain at the level of the thoraces. The surface test is thick and there is a long branchial opening. The upper border of the atrial opening is sometimes produced into a lip. There are four rows of about eight stigmata. The basal layer of test in which the abdomina of the zooids are embedded is rather thick and gelatinous.

Remarks: This species is the most common ascidian in the particularly rich ascidian fauna at Crawfish Rock. The characteristic marking caused by greyish-black stellate pigment cells overlying the common cloacal canals and the thick layer of basal test distinguish the species from *Didemnum candidum* in which there is the same variety in form of the spicules. The common cloacal system is also distinctive in that the thoraces of zooids are not completely enveloped by the cloacal cavity as in *D. candidum and D. moseleyi* but remain embedded in common test opening into the cloacal canals from their dorsal surface. Although the species has been recorded from Port Jackson and from St. Vincent Gulf it is never present in the same high density as at Crawfish Rock and it has never been reported from Port Phillip Bay.

Didemnum turritum Michaelsen

(Figs. 19, 20)

Didemnum turritum Michaelsen, 1930, p. 521. Kott, 1962, p. 319.

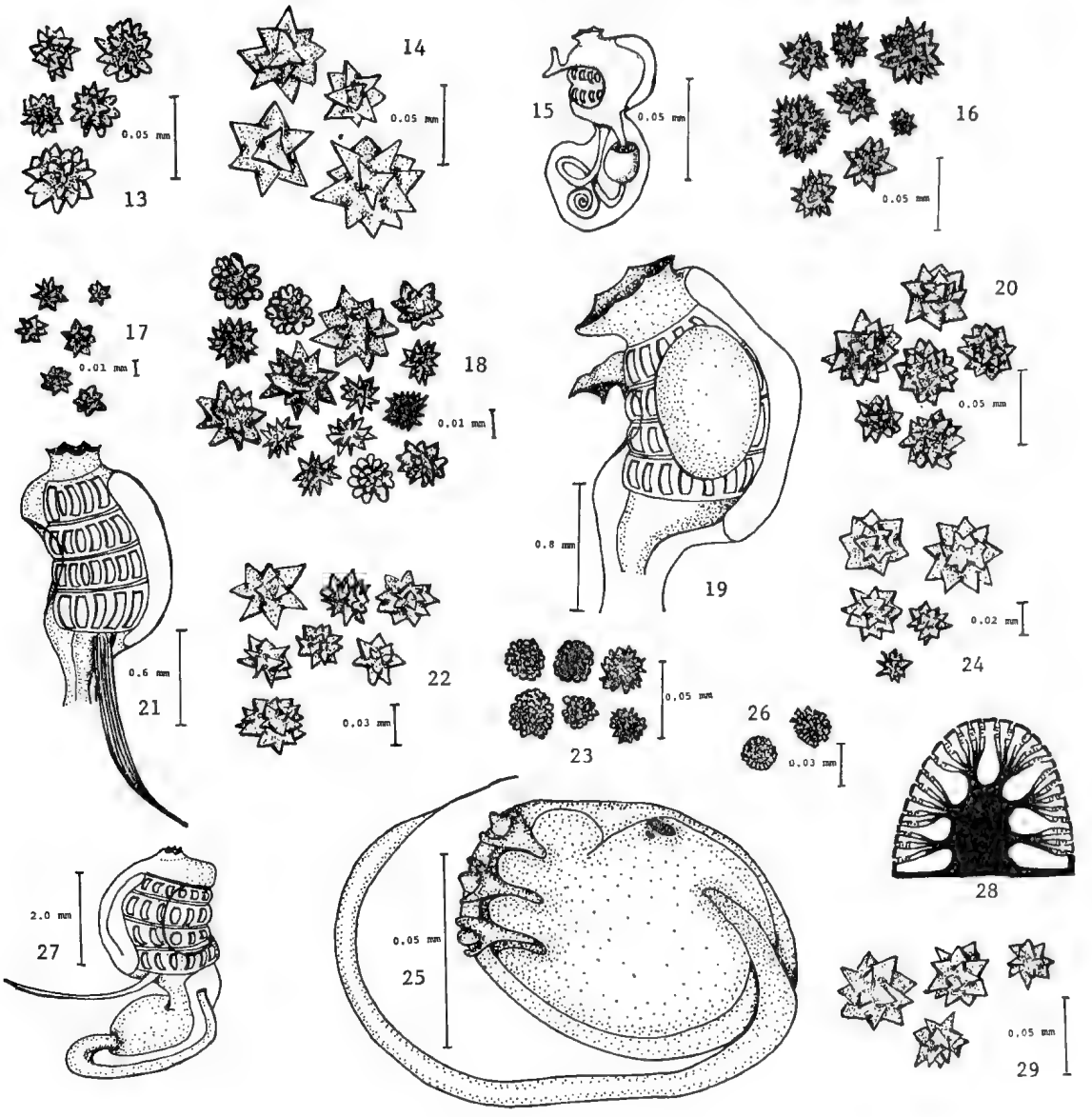
New Records: Western Port (Crawfish Rock; Eagle Rock).

Distribution: S. W. Aust.; S. Aust.: St. Vincent Gulf.

Description: Pinkish investing colonies. Large cloacal apertures are scattered over the surface. The branchial apertures are also conspicuous owing to the density of spicules in the test covering the branchial lobes. A single lobe of the branchial aperture sometimes developes a hollow pointed papilla from its base. Small rounded pigment cells line the common cloacal cavities. The surface of the test may be depressed over the deep primary common cloacal canals to form furrows on the surface. Clumps of zooids are surrounded by these deep primary canals which sometimes extend posterior to the abdomina of zooids. The secondary cloacal cavities are thoracic. The spicules are regularly stellate with about seven conical rays in section and are 0·3 to 0·4 mm in diameter. The thorax of each zooid is about 1·0 mm long with large oval lateral organs which occupy a pronounced pit in the thoracic wall along most of its length. The branchial siphon has a well defined circular sphincter muscle but is not very long although the surface layer of test is thicker than that of either *D. candidum* or *D. moseleyi*. The atrial aperture is extensive exposing most of the dorsal part of the branchial sac and sometimes its anterior border is produced into a pronounced forked lip. The thoracic retractor muscle was not detected.

There are four rows of about eight stigmata. The gonads were not distinguishable.

Remarks: The species is readily recognized by the hollow pointed papillae associated with



Tridemnum cyclops
13—spicules.
Tridemnum cerebriforme
14—spicules.
Didemnum candidum
15—zooid. 16—spicules.
Didemnum moseleyi
17—spicules.
Didemnum patulum
18—spicules.
Didemnum turritum
19—thorax. 20—spicules.
Didemnum augusti
21—thorax. 22—spicules.
Didemnum roberti
23—spicules.
Didemnum spongioides
24—spicules. 25—larva.
Lissoclinum fragile
26—spicules.
Diplosoma translucidum
27—zooid. 28—diagrammatic cross section through colony.
Polysyncraton victoriensis
29—spicules.

one of the branchial lobes of each aperture in certain limited areas. These papillae superficially resemble those sometimes occuring in *D. moseleyi* although in the latter species they are not hollow and are not specifically associated with the apertures. The thicker surface test, the relatively large zooid and the large oval lateral organs also distinguish the species.

The hollow papillae protecting the branchial apertures are reminiscent of those in *D. nekozita* Tokioka, 1967, from the Palau Islands and the Philippines. The latter species, however, has distinctive spicules and a thoracic cloacal system.

Didemnum augusti Michaelsen

(Figs. 21, 22)

Didemnum augusti Michaelsen 1920, p. 39. Kott, 1962, p. 323; 1972d, p. 247.
?*Didemnum partitum* Tokioka, 1953, p. 191.

New Records: Western Port (Crawfish Rock). Ram Head (18 miles south of Mallacoota Inlet).

Distribution: S.W. Aust.; S. Aust.: Reevesby Island; Vict.: Balnarring Beach; West Indian Ocean.

Description: Very extensive, thin, investing colonies with dense white spicules, less dense only in the basal test. The spicules are stellate from 0·03 to 0·05 mm with 5 to 7 conical pointed rays in optical cross section. The surface of the test is furrowed and has a cauliflower-like appearance where the surface test is depressed over the deep primary canals. The primary canals extend the whole length of the zooids between pillars of common test in which the abdomina are embedded. Only the dorsal aspect of the thorax is exposed to the common cloacal canals. Some secondary canals are present but the thorax is never enclosed in its own discrete sheath of test. The test along either side of the atrial opening is thickened but there is no lateral organ. The thorax is small, 0·6 mm, with four rows of stigmata. There is a retractor muscle always present.

Remarks: The species is distinguished from *D. turritum* and *D. moseleyi,* which often have the same surface furrows and deep primary canals, by the solid pillars of test in which the zooids are embedded, by the very small thorax, the absence of a distinct lateral organ and by the large spicules with few conical rays.

Didemnum roberti Michaelsen

(Fig. 23)

Didemnum roberti Michaelsen, 1930, p. 516.
Didemnum ternatanum; Kott, 1972b, p. 179.

New Records: Western Port (Crawfish Rock; Eagle Rock).

Distribution: W. Aust.: Shark Bay; S. Aust.: Elliston Bay.

Description: Investing colonies with a smooth surface and dense spicules in the surface and basal layers of test. The common cloacal apertures have their borders stiffened with spicules and are very conspicuous. Some colonies are flattened but in some, rounded lobes are developed by a thickening of the basal test to form a central core of test. There are extensive posterior-abdominal cloacal spaces and the zooids are suspended in clumps between the surface and basal layers of test, anchored basally by a short single strand of test, and at the surface by the branchial lobes of respective zooids. Secondary common cloacal cavities surround the thoraces of the zooid, each surrounded by a discrete layer of test and with a large lateral organ occupying most of each side of the thorax (as in *D. turritum*). The spicules are not so thick in the test surrounding the zooids. The surface test is fairly thick, again resembling *D. turritum.* Spicules are almost spherical, 0·02 to 0·04 mm in diameter with rounded rays. The zooids are small. The testis follicle is undivided and has 7½ coils of the vas deferens around it.

Remarks: The present colonies diverge from Michaelsen's (1930) specimens only in the presence of spicules throughout basal or axial test. In the Shark Bay material the basal layer of spicules was confined to a layer beneath the posterior abdominal canals to form a sort of endoskeleton.

Colonies from Elliston Bay (Kott, 1972b) which are identical with the present colonies from Western Port, were erroneously assigned

to the species *Didemnum ternatanum* Gottschaldt. Although the three-dimensional common cloaca and the size and form of the spicules are similar to those of *D. ternatanum,* the present species is distinguished from it by its external, oval lateral organ, by the more densely distributed spicules; by the multiplicity of common cloacal apertures and extensive colony; and by its firmer consistency. *D. roberti* is distinguished from *D. bistratum* Michaelsen, 1920 from West Africa by the form of its spicules (those of the latter species are spherical and hollow) and by its external lateral organ. *D. spongioides* also has a similarly labyrinthine common cloaca, but its spicules are stellate, with fewer, conical rays, and fewer coils of the vas deferens.

Didemnum roberti has previously been described as yellow, or yellowish—no information is available on the *in vivo* colour of the present colonies.

Didemnum spongioides Sluiter

(Figs. 24, 25)

Didemnum spongioides Sluiter, 1909, p. 67. Kott, 1962, p. 318; Eldredge, 1967, p. 193.

New Records: Western Port (Crawfish Rock).
Distribution: Caroline Is.; Indonesia; W. Aust.: Rottnest Island; Tas.: Oyster Bay. The records suggest a circum-Australian distribution.
Description: Colonies are rounded to conical with a terminal common cloacal cavity. The test is firm. Spicules are present in a layer beneath a surface layer of bladder cells at the level of the branchial siphons. They are less dense beneath this layer and are entirely absent from the test core that occupies the centre of the colony. The surface of the test is covered with minute spicule-filled pointed papillae that project through the bladder cell layer and, when magnified, give to the surface a spotted appearance.

The spicules are stellate with about seven conical rays in cross section, and range from 0·02 to 0·06 mm in diameter. An extensive common cloacal cavity separates the outer spicule and zooid bearing layer of test from the inner spicule free test core in which embryos develop. Cloacal canals extend into the zooid bearing layer but these do not separate clumps of zooids from one another. The openings of the common cloacal canals into the posterior abdominal chamber are shown by Sluiter (1909, Plate 6, fig. 9) and the ridges and trabeculae he describes are formed by the roof of the cloacal chamber enclosing abdomina of zooids projecting into the chamber, between the openings of the canals. These ridges and trabecula are not the imprint of the substrate on the base of the colony as Eldredge (1967) has suggested. Zooids are small. The thorax, when contracted is only 0·5 mm long. There is a wide atrial opening and a small rounded lateral organ opposite the 4th row of stigmata. The vas deferens coils 6½ times around the undivided testis follicle.

Embryos are packed in the central test core at the base of the common cloacal chamber, into which they move through the occasional strands of test that connect the surface layer to the central core. They are 0·9 mm long when mature, have an ocellus and an otolith, and four pairs of lateral ampullae. The tail winds once around the embryo.
Remarks: The species is related to *D. lambitum* in the form of cloacal system and the spicules and is distinguished from that species by the presence of a bladder cell layer and by the larva in which the ampullae are not subdivided.

D. spongioides; Eldredge, 1967, differs from the present specimens in the presence of pigment cells, the even investing form of the colony and in the condition of the cloacal system with well developed thoracic secondary canals and primary canals extending posteroabdominally but not forming a continuous space separating surface from central or basal test. The thickness of the surface layer of test, the arrangement of cloacal canals, the spicule form, size and arrangement, and the presence of pigment cells of Eldredge's specimens are identical with those of *D. turritum* from which they differ only by the absence of hollow pointed papillae on the surface.

The colony is typically "sponge-like" in external appearance, rounded and sessile.

Didemnum lambitum (Sluiter)

Didemnoides lambitum Sluiter, 1900, p. 18.
Didemnum lambitum; Kott, 1962, p. 317 and synonymy; 1971, p. 19; 1972a, p. 18.

New Record: Port Phillip Bay (Hobson's Bay).
Distribution: N. Z.: Chatham Island, North Island, South Island, Stewart Island; Tas.; S. Aust.: St. Vincent Gulf.
Description: The colonies are more or less fan shaped, made up of vertical lamellae or columns. These may fuse for the greater part of their length, or only basally or terminally. The free outer edge of the fan is more or less flattened. Common cloacal apertures are large and rounded and are occasionally but not always found on the free ends of the lobes. The test is firm and gelatinous, without sand. There is a central gelatinous core of test surrounded by specially extensive common cloacal spaces. The zooids are small and numerous, closely packed in the outer layer of test. There are 8½ coils of the vas deferens around a single undivided testis follicle.
Remarks: This species appears to be limited to the more temperate waters of Australia and New Zealand extending north only to N .S. W. on the east coast of Australia. The spicules are usually present in the surface test at the level of the zooids but are often absent in the remainder of the test. In one of the present colonies spicules are absent entirely. The relationship of the present species to *D. spongioides* is close. Both have a firm gelatinous test and a similar common cloacal system. In both the spicules are usually absent from the central test core and form a layer only at the level of the branchial siphons. In both they are stellate with about seven conical pointed rays. The species appear to be distinguished only by the absence of a superficial bladder cell layer in *D. lambitum* and by the larvae which, in the latter species, has subdivided lateral ampullae. Generally the colonies of *D. lambitum* are higher than those of *D. spongioides. D. spongioides* has been recorded from the tropics but *D. lambitum* has not. It is possible that both species represent different stages in development of a single species, however, additional specimens, together with larvae will be needed to resolve the question.

Didemnum skeati (Sollas)

Hypurgon skeati Sollas, 1903, p. 729.
Didemnum psammatodes var. *skeati;* Michaelsen, 1920, pp. 22, 27 and synonymy. Hastings, 1931, p. 95, Kott, 1962, p. 326.

New Records: Western Port (Crawfish Rock; Eagle Rock).
Distribution: Malaysia; Indian Ocean; Vict.: Flinders; Qd.: Moreton Bay, Sarina, Low Isles; Torres Strait: Possession Island. The species has not been recorded from Western Australia but in view of its Indian Ocean occurrence could be expected to occur there.
Description: A large number of extensive sheets, blackish in colour owing to embedded balls of mud throughout the test. Small groups of spicules, as previously described, are present over each branchial aperture. The cloacal canals are thoracic. Zooids are very small.
Remarks: The specimens conform completely with previous descriptions. In view of the constant nature of this form and its consistent differences from *D. psammatodes,* it has been elevated to specific rank.

Lissoclinum fragile (Van Name)

(Fig. 26)

Diplosomoides fragile Van Name, 1902, p. 570.
Lissoclinum fragile; Eldredge, 1967, p. 245 and synonymy.
? *Diplosoma* (sic) *caulleryi* Ritter and Forsyth, 1917, p. 489.
? *Lissoclinum caulleyri;* Van Name, 1945, p. 114.
? *Lissoclinum marpum* Millar, 1953, p. 301.
? *Lissoclinum bilobatum* Millar, 1955, p. 180.
? *Lissoclinum japonicum* Tokioka, 1958, p. 73.
? *Lissoclinum notti* Brewin, 1958, p. 457.

New Records: Western Port (Eagle Rock)
Distribution: West Indies; ? East Africa; ? South Africa; ? Japan; Pacific; ? California; ? New Zealand. Except for *Lissoclinum fragile* Van Name and *Lissoclinum caulleryi* Ritter and Forsyth, the suggested synonyms are known only from single records. The present specimen is the only record from Australia. The lack of records may be explained by the brittle nature of the very thin investing colony which is removed from the substrate only with the greatest difficulty. The species is probably

circum-tropical and extends into temperate regions of both the northern and southern hemispheres.

Description: The colony is thin and extensive, investing a very large specimen of *Ascidia sydneysis*. There are pinkish brown pigment cells in the surface test. Spicules are very dense throughout, and the colony is very brittle. Spicules do not line the branchial lobes and are absent from a circular area in the region of the branchial aperture through which the interior of the colony is visible. They are small, 0·02 to 0·03 mm in diameter, burr-like with many flat ended rays. The cloacal cavity is mainly thoracic, primary canals sometimes extend to the abdominal level but never posterior to the zooids. The abdominal portion of the zooids is embedded in the basal test which is very solid and hard owing to the density of spicules. The thoraces cross the cloacal cavity in independent test sheaths that are interrupted over the dorsal surface and most of each side of the thoraces they envelope. A very large 'flap like' lateral organ is present supported on the edge of the test sheath near the ventral border of the zooid and overlapping the branchial sac opposite the interval between the third and fourth rows of stigmata. There are four rows of stigmata with eight stigmata in each row. There are two testis follicles with a straight vas deferens, hooked proximally around between the two testis follicles.

Remarks: The synonymy suggested above was first indicated by Kott (1962). The specimens all have a deeply indented atrial aperture, a similar two dimensional cloacal system, and similar spicules within the same size range although there is some variation in their density and arrangement. The lateral organ is usually present and is flap-like and opposite the third to fourth rows of stigmata in all cases except in *L. fragile;* Tokioka, where it appears to be elliptical, not supported on the edge of the test sheath and opposite the second row of stigmata. In *L. fragile;* Eldredge, it is described as a "small flap-like" organ and in *L. marpum* Millar it is also small. In *L. fragile* Van Name it is not always present and has not been described at all for *L. notti* Brewin.

Its presence and degree of development is, therefore, apparently variable and its use as a distinguishing character would not in any case resolve the taxonomy of the forms indicated above on any rational geographic ground.

Larvae have been described for *L. notti* Brewin and *L. fragile;* Eldredge. They are identical in size and form although some of Eldredge's specimens had a layer of small opaque particles surrounding the larval body similar to the particles described for *L. ostrearium;* Kott (1962).

The present species differs from *L. ostrearium* Michaelsen and *L. molle* Herdman in the absence of a three dimensional cloacal system.

Lissoclinum ostrearium Michaelsen

Lissoclinum ostrearium Michaelsen, 1930, p. 526. Kott, 1962, p. 308 and synonymy.

New Records: Western Port (Crawfish Rock; Flinders Jetty).

Distribution: W. Aust.: Rottnest Island; S. Aust.: St. Vincent Gulf; Qd.: Great Barrier Reef.

Description: The colonies are very thin investing and rather delicate. There are some black pigment particles in some parts of the colony. There is a thin layer of surface test. The basal test is thicker, sometimes enclosing abdomina but more often clumps of zooids are anchored to the basal test by a single narrow strand of test. The common test then subdivides to enclose each zooid in an independent test sheath for almost its whole extent and anchoring it anteriorly to the surface test. Each individual test sheath is interrupted dorsally to expose a large part of the dorsal surface and sides of the branchial sac to the extensive common cloacal cavity. The spicules are distributed in varying density in different parts of the colony and are often almost entirely absent. They are less dense in the surface layer than in the remainder of the test. The spicules are 0·025 to 0·03 mm in diameter and are characteristic, with a large number of flat-ended rays. There is a small, flap-like lateral organ opposite the interval between

the third and fourth rows of stigmata. No embryos are present in these Victorian colonies.
Remarks: The atrial aperture and the lateral organ are similar to those of *L. fragile*. They are distinguished only by the colony which demonstrates a maximum development of the cloacal system as in other species of *Lissoclinum* and *Diplosoma*.

Eldredge (1967) drew attention to the fact that the difference in the shape of the stigmata is probably not a valid character to distinguish *L. fragile* and *L. ostrearium*. It is possible that the shape of the stigmata is affected by the extent to which colonies with dense spicules retain their original shape when preserved in formalin so that the branchial sac is maintained in an extended condition by the rigid test.

Diplosoma translucidum (Hartmeyer)

(Figs. 27, 28)

Leptoclinum translucidum Hartmeyer, 1909, p. 1490
Diplosoma translucidum; Kott, 1962, p. 306 and synonymy.

New Records: Western Port (Eagle Rock).
Distribution: W. Aust.: Oyster Harbour, Albany; N. W. Aust.; Indonesia.
Description: The colony is long, narrow and irregular investing a worm tube. It has a transparent test that is fairly soft but tough and not jelly-like. The basal test is extended upwards in a lamella along the mid-longitudinal axis of the colony. Strands of test from both sides of this lamella support clumps of zooids. The common test then subdivides to form test sheaths supporting the thorax of each zooid independently at the surface. The zooids are fairly large with the thorax about 2 mm long. There are four rows of about 10 stigmata. A large part of the branchial sac is exposed through the wide atrial opening. There is a long rectum. Oesophageal buds are present, but gonads were not distinguished.
Remarks: The species is distinguished from *D. rayneri* by its firmer test and, although the cloacal system is typical of the genus with long test strands anchoring the zooids basally, the secondary cloacal spaces are not so well developed and zooids tend to remain in clumps. This also gives the colony a firmer consistency.

Diplosoma rayneri MacDonald

Diplosoma rayneri MacDonald, 1859, p. 373.
Leptoclinum (Leptoclinum) rayneri; Kott, 1966, p. 290.
Diplosoma listeranum; Rowe, 1966, p. 458 and synonymy.
Diplosoma macdonaldi; Eldredge, 1967, p. 231.

New Records: Western Port (Crawfish Rock).
Distribution: Cosmopolitan (see Rowe, 1966).
Description: Typical delicate colonies. Vegetative reproduction in progress. No mature gonads observed.

Polysyncraton orbiculum Kott

Polysyncraton orbiculum Kott, 1962, p. 301, Kott, 1872a, p. 21.

New Records: Western Port (Crawfish Rock).
Distribution: W. Aust.: Rottnest Island; S. Aust.: St. Vincent Gulf.
Description: The colonies are small and investing with the usual circle of large vesicular cells around each branchial aperture. There is a single layer of spicules in the surface test, interrupted by these large vesicular cells. The zooids, with the red brown pigment in them, give to the colony a pinkish brown colour. Sometimes the vesicular cells are so large that they are almost confluent. Because these cells are transparent and interrupt the distribution of spicules the surface of the test appears to be pitted, or, when they are almost confluent, it appears to be depressed into a narrow trough or furrow around each opening so that the apertures are at the apices of apparent mounds over each zooid. The spicules are 0·02 to 0·03 mm in diameter and are regularly stellate with about eight conical rays in optical section.

The cloacal canal is shallow and thoracic, the zooids small and completely embedded. Gonads were not detected.
Remarks: The form of the colony and arrangement of spicules has been used to determine this species.

Polysyncraton victoriensis n. sp.

(Fig. 29)

Type location: Western Port (Crawfish Rock, 8 m, on *Ecklonia* holdfasts) *Holotype,* National Museum of Victoria No. H. 171.

Description: The colony forms a thin investment over weed. It is a rather dirty whitish colour in formalin. There is a layer of bladder cells superficially over the top of each zooid. Between the zooids, however, spicules invade the superficial layer of test which stands out as spicule filled ridges between the zooids and gives an irregular and rather angular appearance to the colony. Zooids thus appear to open into the base of furrows on the surface. There is a very shallow common cloacal cavity. Spicules are stellate, 0·03 to 0·06 mm in diameter with only five conical rays in section. They are arranged evenly throughout the test. Zooids are small. There are four rows each of six stigmata in the branchial sac. There are 4½ coils of the vas deferens around three to four testis follicles.

Remarks: The arrangement of spicules is the same as that described by Hastings, 1931 for *P. magnetae.* Hastings species, however, has smaller spicules, fewer turns of the vas deferens, more testis follicles and more stigmata.

Phallusia depressiuscula (Heller)

Ascidia depressiuscula Heller, 1878, p. 5.
Phallusia; depressiuscula; Kott, 1972a, p. 23 and synonymy.

New Records: Western Port (Flinders Jetty; Tankerton Jetty); Port Phillip Bay (Hobson's Bay; artificial reef). Portland Harbour 6-12 metres, on rocks forming jetty.

Distribution: Ceylon; Indonesia; Arafura Sea, Philippines; circum-Australia.

Description: The present specimens fall within the range previously indicated for this species. Large specimens from Portland Harbour are black; while the smaller specimens and specifrom Flinders jetty, up to 20 cm in length and fixed by the whole of the left side, are brownish and translucent. One of these large specimens is completely invested with *Lissoclinum fragile.*

Ascidia sydneyensis Stimpson

(Fig. 30)

Ascidia sydneyensis Stimpson, 1855 (? part), p. 387. Kott, 1972a, p. 24 and synonymy; 1972, p. 182; 1972c, p. 237; 1972e, p. 49.

New Records: Western Port (Tankerton Jetty, Flinders Jetty, Crawfish Rock, Eagle Rock); Port Phillip Bay (Williamstown, Hobson's Bay; artificial reef).

Distribution: West Indies; South and east Africa; Indian Ocean; Indonesia; circum-Australian. The species is apparently circum-polar in tropical and temperate waters of the southern hemisphere although it extends north of the tropics only to Japan.

Description: Large specimens at least 10 cm long and up to 20 cm are available from all stations, fixed by the whole of the left side. The apertures are on the usual short cylindrical siphons, the branchial aperture is always turned to the left toward the substrate. The atrial aperture from half way down the body is turned to the right or directed anteriorly along the dorsal surface. Sometimes the whole antero-dorsal part of the body is turned over to the left. The test of these large specimens is firm and gelatinous and slightly leathery superficially except along the left side where it is fixed to the substrate and there it is very thin. Two of the four large specimens from Flinders jetty are completely covered by investing didemnids. On one specimen there is a colony of *Didemnum* posteriorly and a colony of *Tridemnum cyclops* anteriorly, which leaves only the branchial aperture free. These colonies overlap one another across the upper surface in a line with the atrial aperture which is also left free. On the other specimen the upper surface is completely invested with a colony of *Tridemnum cyclops.* There the branchial aperture is free but the atrial aperture is covered and the excurrent stream from the *Ascidia* is apparently directed along a groove in its test to the left of the line between the atrial and branchial siphons and underneath the encrusting didemnid. The gut, in all these specimens, is filled with mud and the branchial sac is occluded by the distended gut.

Ascidia gemmata Sluiter

Ascidia gemmata Sluiter, 1895, p. 177. Kott, 1972a, p. 26 and synonymy.
Ascidia thompsoni; Kott, 1975, p. 10.

New Records: Port Phillip Bay (Mornington Pier).

Distribution: Pacific; Malaysia; Indonesia; Arafura Sea; circum-Australia. The species thus appears to have a wide range in the Indo-Pacific area.

Description: Two specimens are available, about 20 cm long. The branchial aperture is terminal on a short siphon. The atrial aperture is sessile, two-thirds of the way along the dorsal surface. There is a long furrow extending along the right side of the body and the atrial aperture is directed into that furrow. The animal is fixed by the whole of the left side. The test is firm, gelatinous and smooth on the surface.

Internally the siphons are more conspicuous. There are 60 branchial tentacles, the dorsal tubercle fills the peritubercular area. The prebranchial region is minutely papillated. The dorsal lamina has the usual strong ribs on both sides, each rib terminating in a minute pointed tongue to form a marginal fringe. The dorsal gland and ganglion are one third of the distance down the body. There are intermediate papillae in some parts of the branchial sac in addition to the papillae at the junction of the transverse and parastigmatic vessels. The oesophageal opening is just posterior to the base of the atrial opening and branchial sac extends posteriorly to it.

Remarks: The species has not yet been recorded from Western Port Bay but will, very likely, be found to occur there.

Botrylloides leachi (Savigny)

Botryllus leachii Savigny, 1810, p. 7.
Botrylloides leachi; Kott, 1972a, p. 29 and synonymy; 1972b, p. 185; 1972d, p. 253.

New Records: Western Port (Crawfish Rock); Portland Harbour (6 metres, on rocks forming jetty).

Distribution: The species is recorded from the north Atlantic the Mediterranean and Red Sea, South Africa, and Indo-Australia to New Zealand. The species does not extend into the south Atlantic. In view of its south African occurrence could be expected to occur more widely in the Indian Ocean than its present records suggest.

Description: As previously described.

Botrylloides nigrum Herdman

Botrylloides nigrum Herdman, 1886, p. 50. Kott, 1972c, p. 238 and synonymy; 1972d, p. 252.

New Records: Western Port (Crawfish Rock; Eagle Rock). Port Phillip Bay (artificial reef; Mordialloc). Cape Nelson (near Portland; 5 metres).

Distribution: West Indies; Red Sea; Ceylon (?); South and East Africa; S. W. Aust.; Vict.; N. S. W.; Qld. The species is not as commonly recorded as other *Botrylloides* spp.

Remarks: The double row systems, widely spaced in irregular lamellae are distinctive and it seems unlikely that the species could be misidentified. Distribution is not circum-polar, as it has not been recorded from the West African coast, nor from the Pacific Ocean.

It may be that there are two species represented, one from the Atlantic and one from Indo-Australian waters.

Symplegma viride Herdman

Symplegma viride Herdman, 1886, p. 144. Michaelsen, 1918, p. 101 and synonymy. Kott, 1952, p. 252 and further synonymy; 1964, p. 129.

New Records: Western Port (Crawfish Rock, growing on basal surface of fronds of *Didemnum patulum*, encrusting a lump of tar).

Distribution: West Indies, Red-Sea, West Indian Ocean, Ceylon, Malaysia, the Philipines and circum-Australian from Shark Bay (W. Aust.) and south across the southern coast to Thursday Island (off N. E. Australia).

Remarks: Colonies of this species appear to compete with didemnids for available space and occasionally overgrow the borders of a didemnid colony.

Amphicarpa diptycha (Hartmeyer)

(Figs. 31-34)

Distomus diptychos Hartmeyer, 1919, p. 87.
Ampicarpa diptycha; 1972e, p. 50 and further synonymy.
Stolonica australis Michaelsen, 1927, p. 202. Kott, 1972a, p. 28 and further synonymy; 1972b, p. 183; 1972c, p. 252.

New Records: Western Port (Crawfish Rock). SSW. of Cape Grant (220 to 275 metres, on a large stone); South-east of Portland (166 to 220 metres).

Distribution: North to south-western Australia; S. Aust.; Vict.; Tas. (d'Entrecasteaux Channel). The species is known from 12 to 24 metres depth.

Description: Upright oval to elongate individuals are joined to a basal membrane or on a short stalk from basal stolons investing sponges or stones. In some colonies individuals are tightly packed to give a cauliflower-like appearance. The test of adjacent zooids is not confluent, however, and the zooids in the colony are connected with one another only by the basal stolon or membrane and by the adherence of adjacent zooids to the same sand particle. The test is covered with sand. Posteriorly where it joins onto the basal membrane, the test may be flattened to form a wide pseudo-stalk. Zooids are up to 8 mm tall and 3 mm in diameter. The branchial apertures are sessile and a short distance down the dorsal surface. The musculature of the body wall is strong especially on and around the siphons but posteriorly becomes weaker. The branchial folds are high and overlapping. There are 19 rows of stigmata. The gut forms the usual short loop across the posterior end of the body and the rectum continues anteriorly at right angles to the loop. The stomach is pyriform, expanded towards the pyloric end. There are 18 longitudinal folds in the stomach wall and on the lateral aspect these folds terminate against the sutureline and appear to be oblique rather than longitudinal. The gastric caecum is continuous with the suture. It extends towards the pole of the gut loop and curves around just distal to the pyloric end of the stomach. It is tightly held against the stomach by a body wall membrane. It is of variable length sometimes curved or hooked or forming one complete spiral. There is the usual ligament extending between the intestine and pyloric end of the stomach enclosing a flat topped endocarp in the pole of the gut loop. There is another similar endocarp between the oesophagus and the end of the intestine where the rectum curves anteriorly.

The anus terminates in two rounded lips. Bisexual gonads are present consisting of a large ovum and a wide short oviduct with a small male follicle beneath the ovum and the body wall, the vas deferens curving around to open on top of the oviduct. These gonads extend in a single row along the middle of the right side of the body and occasionally further towards the ventral margin. On the left they usually extend in a line obliquely across the anterior border of the gut loop and along the ventral border of the body. Ovaries only occur together with testis follicles, although occasionally the male gland appears to be spent or not to be mature. Numerous testis follicles, however, are often scattered in clumps antero-ventrally and postero-dorsally at either end of the right row of the bisexual gonads and on the left of the body they extend around the ventral margin anterior to the stomach and ventral to the bisexual gonads. This condition appears to occur in fully developed mature zooids. In less well developed zooids the unisexual testis follicles are not present and the testes are confined to the bisexual organs as described. Larvae are present in colonies from Crawfish Rock. They have the usual photolith and a circle of 16 ampullae anteriorly from the centre of which three simple papillae diverge. The larval test has a foamy vesicular appearance.

Remarks: A large number of zooids have been examined in order to resolve the confusion between this species and *Stolonica australis* caused by the variable length of the gastric caecum, variation in development and position of the gonads and variation in the development of the colony. The essential differences between *Stolonica australis* and *Amphicarpa diptycha* (viz. the density of the zooids in the colony and the position of gonads on the body wall) are both extremely variable and are related to the condition and age of the colony and the maturity of the gonads, and the zooids. Similarly the extent to which the basal stolons associated with *S. australis* have fused to form a basal membrane and the

stalk of the zooid has expanded to become confluent with that of adjacent zooids probably depends on the maturity of the colony. It is apparent from the zooids in the present collection, all from the same location, that no essential difference separates these species. In the present specimens there is an encapsulated parasitic copepod in the peribranchial cavity of most individuals.

Polyandrocarpa lapidosa (Herdman)

Goodsiria lapidosa Herdman, 1899, p. 99.
Polyandrocarpa lapidosa; Kott, 1952, p. 250; 1972b, p. 184; Millar, 1963, p. 730.

New Records: Port Phillip (Survey area 5; Popes Eye, Port Phillip Heads).

Distribution: Port Phillips Heads, Western Port. New South Wales (Port Jackson).

Description: Colony forms a large flattened lobe with zooids opening around both sides. The zooids conform to previous descriptions of this species.

Polycarpa thelypanes (Sluiter)

Stylea thelypanes Sluiter, 1904, p. 68.
Polycarpa thelypanes; Kott, 1952, p. 238.

New Records: Western Port (Flinders Jetty). South to south-east of Portland Harbour, 166 to 220 metres.

Distribution: Philippines; W. Aust.: Albany. Kott, (1952) suggests that the species might have been introduced to Australia with Japanese oysters *(Ostrea gigas)* with which it was taken. The present records, however, suggest that this sandy inconspicuous species may have a wider range than previously recognised.

Description: One small specimen is available from Flinders Jetty growing on the test of a specimen of *Ascidia sydneyensis*. A single small specimen and four large specimens are available from off Portland Harbour. The test is very stiff and impregnated with sand. The body wall is not very muscular and closely adherent to the inner surface of the thin, brittle test. The specimens are either dorso-ventrally flattened or laterally flattened and lie on the substrate on their right side. They are not, apparently, fixed to the substrate but lie freely on it. The branchial aperture rises from the anterior end of the body and is directed at right angles to its long axis. The atrial aperture rises from about half way along the dorsal surface. The test is tough leathery and whitish. It is impregnated with sand everywhere except on the short cylindrical siphons. The siphons are longitudinally furrowed and entirely free of sand. In laterally flattened specimens the branchial aperture is turned over to the right towards the substrate. There is a simple U-shaped dorsal tubercular opening in a large peritubercular area. The body wall is closely adherent to the test and has very delicate though strong muscles that radiate from the siphons but fade out on the body. The branchial sac has four very low rounded folds on each side of the body with wide spaces between them. There are about 15 internal longitudinal vessels on the folds and 9-12 between the folds. There is a very short, rounded stomach and the gut forms a wide open arc opening by an eight lobed anus into the base of the atrial aperture. The gonads are intermediate between long styelid-type gonads and shorter polycarps. There are about eight on both sides of the body more or less in a row near the endostyle with others irregularly scattered over the body wall. Sometimes the gonads are slightly curved and bent.

Remarks: The form and arrangement of gonads, the course of the gut and the rigid, thin and stiff test characterise this species. It is of interest that the siphons remain the only contractile part of this animal, the remainder of the body wall is closely adherent to the test. The plane along which the animal is flattened also appears to be variable and a consequence of its position on the substrate. The flattening of the body contributes to the orientation of the branchial aperture toward the substrate and the atrial aperture away from the substrate.

Cnemidocarpa etheridgii (Herdman)

(Fig. 35)

Styela etheridgii Herdman, 1899, p. 38.
Cnemidocarpa etheridgii; Kott, 1972a., p. 31 and synonymy; 1972d, p. 253.

New Records: Port Phillip Bay (Mornington;

Port Phillip Heads). South to south-west of Cape Grant, (221 to 275 metres). 280° from Cape Nelson, (220 to 294 metres); Portland Harbour South to south-east of Portland Harbour (166 to 278 metres).

Distribution: W. Aust.: Triggs Island (north of Fremantle); around the south coast of Australia; Tas.: d'Entrecasteaux Channel; N. S. W.: Port Jackson, Port Stephens; Qd.: Moreton Bay.

Description: The test is whitish and tough and leathery, but thin and paperlike in appearance. The branchial aperture is terminal and the atrial aperture one third to half way down the dorsal surface. Both apertures are sessile. The body is more or less conical in outline from the wide rounded basal or posterior portion and narrowing to the terminal branchial aperture terminally. Posteriorly, the test may be produced into numerous tough root-like projections or there may be a single stalk. The test around the apertures is usually longitudinally furrowed or sometimes, when they are withdrawn, is transversely wrinkled. The body wall is closely adherent to the test. The dorsal tubercle is large and protruberant and almost fills the peritubercular area. There is a fairly wide, smooth margined dorsal lamina. The branchial sac has 4 high, almost overlapping folds on each side of the body. There is a single large gonad in the centre of the body wall on both sides of the body, sometimes enclosed in endocarp-like thickening of the body wall. The gut forms the usual long, narrow, curved loop and also encloses an endocarp which may cross from the left to the right side of the body behind the branchial sac.

Remarks: This species demonstrates a wide range in size up to 11 cm in length. It is characteristically large and rounded posteriorly, with a typical tough whitish thin test. Internally the high branchial folds, the narrow curved gut loop and the embedded gonads are distinctive. As with *Ascidia gemmata* this species has surprisingly not yet been recorded from Western Port, but is likely to occur there.

Pyura australis (Quoy and Gaimard)
australis Quoy and Gaimard

(Fig. 36)

Ascidia australis Quoy and Gaimard, 1834, p. 614.
Pyura australis, Kott, 1972b, p. 186 and further synonymy.

New Records: Western Port (Crawfish Rock, some fixed to a scallop shell and some with the stalk encrusted with *Amphicarpa diptycha* or attached to *Ecklonia* holdfasts). Port Phillip Bay (Portsea).

Distribution: N. W. Aust.: Geraldton; around the southern coast of Australia; Tas.: d'Entrecasteaux Channel; S. Aust.: St. Vincent Gulf; Vict.: Flinders.

Description: The present specimens are typical although the projections from the test are sometimes longer and more pointed than is usually the case. The branchial aperture is turned downwards toward the substrate and protected by large tubercular extensions of the test. There are the usual stellate siliceous spicules 0·03 mm in diameter in the test and pointed spines, less than 0·1 mm in length, lining the siphons. The anal border has the usual long, finger-like lobes.

Pyura cataphracta (Herdman)

(Figs. 37, 38, 39)

Cynthia cataphracta Herdman, 1899, p. 31.
Pyura multiradicata; Kott, 1952, p. 269 (part: *not* Herdman's type specimen of *Cynthia multiradicata* < *Pyura spinifera*).

New Records: Western Port (Crawfish Rock). South to south-west of Cape Grant, 220 to 275 metres. South to south-east of Portland Harbour, 160 to 220 metres.

Distribution: Previously recorded only from Port Jackson.

Description: The species is upright, slightly narrowed toward the base. The branchial aperture and atrial aperture are each on a short siphon at opposite extremities of the upper surface. Basally the diameter of the individual is reduced and root-like extensions from the test or a single stalk basally rooted may be produced posteriorly. Externally the test is grooved and furrowed to varying extents and especially anteriorly. The test around the apertures is produced into pointed processes

directed anteriorly around the aperture and depending on the extent to which the siphon is contracted, sometimes extending across the closed aperture. On other parts of the body, the test may be produced into small tubercles. The surface of the test is granular and very hard, impregnated with spherical siliceous bodies. These are 0·30 mm in diameter, have a granular surface, and are densely packed in the superficial test, becoming slightly less dense internally. The test is, however, thin and very tough throughout. Internally the body wall is very thin with very strong longitudinal muscle bands radiating from both siphons and extending posteriorly to break up into an irregular network over the gut-loop and posterior end of the body. Circular muscle bands are thinner but form a more continuous layer outside the longitudinal bands on the upper half of the body. The test is invaginated into the siphonal linings and the same spherical siliceous spicules are present in this siphonal lining. There are also minute pointed spines 0·02 mm long directed toward the aperture. The dorsal tubercle is large, a U-shaped opening directed toward the left with both horns turned anteriorly. The branchial tentacles have primary, secondary and tertiary branches. The prepharyngeal area is fairly narrow. The dorsal lamina has short closely-set pointed languets arising from the border of a narrow membrane. There are six branchial folds on each side of the body with 18-21 internal longitudinal vessels on each fold and two or three vessels between the folds. The gut loop is embedded in the body wall and forms a curved open loop around the posterior end of the body with arborescent liver tubules rising from the pyloric region. The gonads on each side of the body are broken up into about five pairs of polycarp-like sacs either side of a median duct. On the left, the gonad is embedded in the body wall in the primary gut loop; on the right side of the body the gonad occupies a corresponding position. The anal border has six well developed bifid lobes.

Remarks: The most outstanding characteristic of this species is the very hard "sandpaper-like" external test, created by the embedded siliceous spicules. The species may also be distinguished by the test extensions which project especially the branchial aperture.

The species appears to be most closely related to *Pyura pachydermatina* sub. sp. *intermedia* Michaelsen (which it resembles in the form of the anal border, the size and shape of the siphonal spines and in the spherical siliceous bodies in the test. It may be distinguished by the absence of the typically long stalk of *P. pachydermatina* and by the shape of the body with the branchial aperture terminal and not adjacent to the stalk as in *Pyura pachydermatina.* The present species may also be distinguished by the absence of rod-shaped spicules in the test and by its simple dorsal tubercular opening which is not convoluted as in *P. pachydermatina.* The body wall is also less muscular and more closely adherent to the test, a condition which may be associated with the very hard and probably more rigid test.

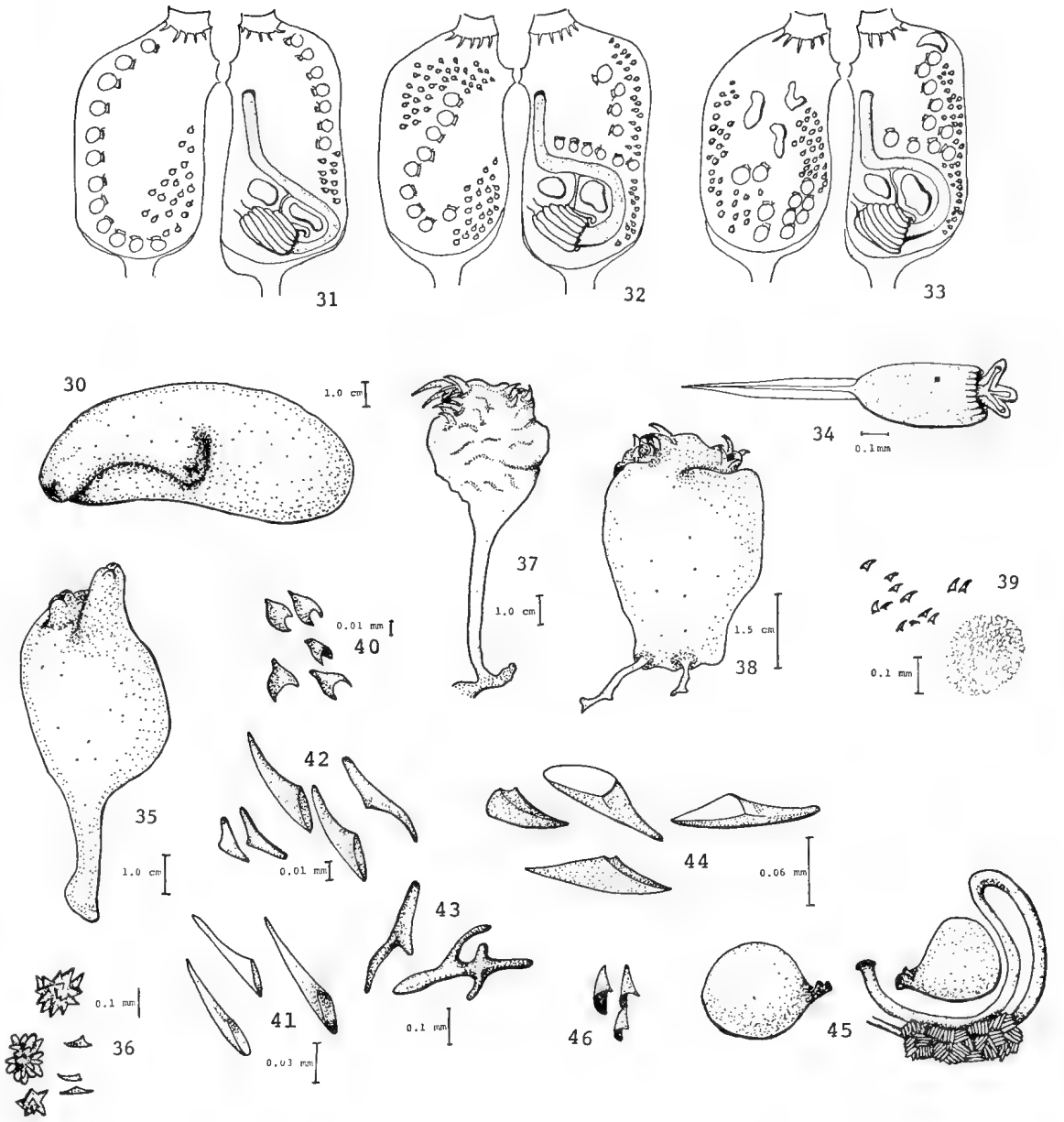
Pyura scoresbiensis Kott

Pyura scoresbiensis Kott, 1972a, p. 36; 1972b, p. 187.

New Records: Western Port (San Remo)

Distribution: S. Aust: St. Vincent Gulf, Spencer Gulf, Investigator Strait.

Description: Specimens comprise an aggregate of sandy spherical zooids on long stalks that taper basally. Both apertures are close together on the upper surface of the individual. The body is about 2 cm in diameter. There is an investment of sand covering the test externally and the bodies of adjacent individuals adhere to one another to form the aggregate where the surface test contacts and adheres to the sand encrusting an adjacent individual. The stalks, however, remain free from one another. There is a slight ridge between the apertures. There are the usual six branchial folds on each side of the body. The gut forms a wide open loop and the rectum extends anteriorly towards the base of the atrial aperture. Arborescent liver lobes are present in the gastric region. The gonads consist of approximately 11 pairs of polycarp sacs on either side of a median duct. They are present in the gut



Ascidia sydneyensis
30—individual showing apertures turned over toward substrate.
Amphicarpa diptycha
31, 32, 33—variable arrangement of gonads on right and left sides of the body. 34—larva.
Cnemidocarpa etheridgii
35—stalked individual.
Pyura australis
36—spicules and siphonal spines.
Pyura cataphracta
37—stalked individual. 38—sessile individual.
39—spicules and siphonal spines.
Pyura irregularis
40—siphonal spines.
Pyura albanyensis
41—siphonal spines.
Pyura stolonifera
42—siphonal spines. 43—spicules from body wall.
Microcosmus stolonifera
44—siphonal spines. 45—gut loop and gonads.
Microcosmus squamiger
46—siphonal scales.

loop on the left side of the body and in a corresponding position on the right.

Remarks: The specimens are smaller than those usually reported for this species. There is also some variation in body shape which is spherical rather than the elongate oval as in the typical specimens described from South Australian locations. Nevertheless, there is no character distinguishing them and it is possible that their small size results from a less favourable location possibly at the eastern extent of the range of this species.

Pyura irregularis (Herdman)

(Fig. 40)

Cynthia irregularis Herdman, 1882, p. 141.
Pyura irregularis; Kott, 1972a, p. 38 and synonymy. 1972b, p. 187.

New Records: Western Port (Crawfish Rock, 8 metres Ecklonia holdfasts; Eagle Rock; Tankerton Jetty); Port Phillip Bay (Mornington Pier).

Distribution: S. Aust.: St. Vincent Gulf; Tas.: d'Entrecasteaux Channel; Vict.: Port Phillip Bay; N. S. W.: Port Jackson.

Description: The present specimens were collected in large aggregates together with *Microcosmus squamiger*. The long siphons are so oriented that they are able to reach the exterior despite the other individuals with which they are so closely aggregated.

Pyura albanyensis Michaelsen and Hartmeyer

Pyura albanyensis Michaelsen and Hartmeyer, 1928, p. 435.
Pyura jacatrensis; Kott, 1952, p. 273.
Pyura vittata; Miller, 1960, p. 126; Tokioka, 1952, p. 134; 1967, p. 202; Kott, 1964, p. 142; 1966, p. 300; 1972a. p. 37; 1972c, p. 243.

New Records: Port Phillip Bay (Mornington)

Distribution: The species has a wide circum-Australian distribution. It has also been recorded from the Palau Is. in the Pacific and from Ascension Is. in the southern Atlantic.

Description: The test is very tough, leathery and wrinkled. There are the usual six high overlapping branchial folds on both sides of the body. The dorsal tubercle is a large, double spiral cone completely filling the peritubercular area. There are needle-like spines lining the siphons about 0·1 mm in length. There are endocarp-like blocks of tissue along the anterior limb of the gut loop. The anal border is bilabiate.

Remarks: This species displays to a very high degree the taxonomic problems that are encountered in the Class Ascidiacea. Species from many localities and with a wide range in characters have been included in the synonymy and Van Name (1921, 1945), Kott (1969, 1972a) and Monniot and Monniot (1972, 1974) have successively made attempts to clarify the situation. Briefly, specimens from the West Indies and the Atlantic, the Indo-Pacific and the sub-Antarctic (Macquarie, Kerguelen and Marion Islands) with siphonal spines variously extending onto the outer wall of the siphons and the gonads separated into polycarp-like sacs along either side of a central duct have been included in the synonymy. Monniot and Monniot (1974) have, most recently, separated the subantarctic form as *Pyura pilosa* characterised by the absence of endocarps on the gut and gonads. In this species the anal border is lobed. The siphonal spines are long and one of its most conspicuous features. Although not described by Monniot and Monniot these spines must be regarded as contributing to the diagnosis of the species.

Indonesian and northern Australian species *P. jacatrensis* Sluiter, 1890; Hartmeyer, 1919; Michaelsen and Hartmeyer, 1928, were included in the synonymy of *P. vittata* by Kott (1969) but were later (1966, 1972a) excluded on the grounds that the branchial spines (0·03 mm) were very much shorter than those of sub-Antarctic and Australian specimens assigned to this species. The anal border in *P. jacatrensis* is simple or very vaguely lobed and there are no endocarps on gut or gonads (Monniot and Monniot, 1974).

The West Indies species share, with specimens from Australia *(P. jacatrensis;* Kott, 1952; *P. vittata;* Kott, 1972a, c), the Arafura Sea (*P. vittata;* Tokioka, 1952), the Palau Islands (*P. vittata* Tokioka, 1967) and Ascension Island (*P. vittata;* Millar 1960), the endocarps along the gut loop that are considered to be characteristic of *P. vittata* by Monniot and Monniot (1974). Other speci-

Pyura albanyensis and related species

	Siphonal spines	Dorsal Tubercle	Colour of Siphon lining	Endocarps on gut and gonads	Anal Border	Range	Synonymy; References
P. vittata (Stimpson, 1852)	?; inconspicuous	medium; horns turned in	red	present	lobed	West Indies; tropical Atlantic; Japan	Van Name, 1945 and synonymy (part: see Monniot and Monniot, 1974)
P. vittata; Tokioka	?; inconspicuous	medium; horns turned in	red	absent	plain	Japan; Palau Is.	Tokioka, 1974b, 1950, 1953
P. pilosa Monniot and Monniot, 1974	needle like 0·1 to 0·2 mm conspicuous	small; crescentic	red	?	lobed	Sub-Antarctic Marion, Kerguelen, Macquarie Is.	*P. jacatrensis*; Kott, 1954, 1969; Millar, 1960
P. albanyensis Michalsen and Hartmeyer, 1928	needle like 0·1 to 0·2 mm conspicuous	large; double spiral cone	greenish	present	plain bilabiate	Palau Is.; Arafura Sea; Darwin; Shark Bay (new record); southern and eastern Australia; Ascension Is., southern Atlantic	*P. jacatrensis*; Kott, 1952. *P. vitatta*; Kott, 1964, 1966, 1972a, c; Tokioka, 1952, 1967; Millar 1960
P. jacatrensis (Sluiter, 1890)	small 0·03 mm inconspicuous			absent	plain	N.W. Australia; Indonesia; Aru Is.	Sluiter, 1904, 1913; Hartmeyer, 1919; Michaelsen and Hartmeyer, 1928

mens from Australia have been re-examined (Pt. Vernon:Kott, 1966; Moreton Bay:Kott, 1964; Ulladulla, N. S. W.: unpublished and Port Gregory, Shark Bay, W. A.: unpublished) and in each case these endocarps are found to be present. All the Australian specimens (Kott 1952, 1964, 1966, 1972a, c) and those from the Arafura Sea and Ascension Island, have siphonal spines of 0·1 to 0·275 mm and these spines confer an irridescent greenish tinge to the siphons of preserved material. In all cases the anal border is bilabate and plain. Specimens from Palau Is. and Japan (Tokioka, 1949b, 1950, 1953) also have a generally plain anal border. However, no endocarps have been described. The spicules have not been described and the siphons are coloured red. The West Indies species differs from the Australian and sub-Antarctic forms in the less conspicuous siphonal spines (for which the length has not been given: Van Name, 1945 p. 322 "minute short spines, visible only on some magnification"), the anal border is lobed, and the siphons are coloured red as in the Japanese specimens. *C. vittata;* Oka and *C. karasboja* Oka (Oka, 1935) are identical with the West Indies form in all characters. It is apparent, therefore, that there are several species involved in this complex each characterised by a reliably constant assemblage of characters and in some cases with an overlapping geographical range, as set out in the following Table.

The specimens set out in the synonymy above conform with the description of *P. albanyensis* Michaelsen and Hartmeyer.

Pyura stolonifera (Heller) subsp. **praeputialis** Heller

(Figs. 42-43)

Cynthia stolonifera Heller, 1878, p. 10.
Cynthia praeputialis Heller, 1878, p. 12.
Pyura stolonifera f. waia Michaelsen and Hartmeyer, 1928, p. 433.
Pyura stolonifera; Sluiter, 1927, p. 43; Kott, 1952, p. 274; MacNae and Kalk, 1958; Kott, 1964, p. 141; Monniot, 1965, p. 100; Day, 1974, p. 35.
Pyura praeputialis; Millar, 1963, p. 738; 1966, p. 372.

New Records: Western Port (Eagle Rock); Port Phillip Bay (Mornington; Hobsons Bay; Prince George Light). Ram Head (18 miles south of Mallacoota, 6 metres).

Distribution: P. stolonifera stolonifera; Cape Province and Natal (South Africa); Mosambique; Dakar; Morocco. *P. stolonifera praeputialis:* S. W. Aust.; S. Aust.: Outer Harbour; Vict.; N. S. W.; Qd.: Noosa. The range around the Australian coast is clearly defined and accompanied by a decrease in the size of the individuals at either end of this range (south-western Australia and Noosa, Queensland).

Description: A single specimen is available from Mornington and a tight aggregate of seven individuals from Ram Head. The specimens are of the usual pillar-like form, maximum height 3-10 cm and maximum diameter, across the top of each individual, 2-4 cm. In the specimen from Mornington the posterior end of the test is produced into irregular processes for adherence to a rocky substrate. The specimens have the usual convoluted double spiral slit on the large hemispherical dorsal tubercle with the open interval directed anteriorly. The dorsal lamina has pointed languets, there are six to seven high overlapping branchial folds on each side of the body and the gut forms the usual curved loop terminating in an anus bordered by three shallow lobes. The liver is large and consists of dense arborescent tubules. The body musculature is strong and branches of the longitudinal muscles from the siphons are inserted into a rim of the body wall around the anterior surface. These muscles effect the anterior depression around the siphons that is characteristic of the species. Strong longitudinal muscles extend only halfway down the body. The siphonal spines are from 0·05 mm to 0·08 mm long, becoming larger toward the aperture. Calcareous spicules (as described by Millar, 1962 for South African specimens) are present in the ventral part of the body wall, in the gut and in the endostyle. Gonads are divided into large paired blocks, densely arranged along either side of a central duct, in the gut loop on the left and in a corresponding position on the right. In older individuals there is a fold of tissue which extends across the body in front of the atrial aperture effectively cutting off the posterior part of the peribranchial cavity as an excurrent

chamber. There is also a dense "fur" of pointed papillae on the body wall of older specimens in which gonads are more or less embedded in the body wall.

Remarks: Kott (1952) has described two environmental forms of this species one from estuarine localities and one from open coast situations. The typical estuarine form is characterised by the presence of a sandy investment on the test and is usually short; and posteriorly the test is produced into a beard of sandy roots; while the open coast form is pillar-like owing to the posterior thickening of the test to form a wide solid gelatinous stand of the same or of only slightly lesser diameter than the rest of the body, thus raising the individual above the substrate. Specimens intermediate between these two forms are known and the present specimen from Mornington Pier in which the test is produced into irregular processes reflects the variability in growth of the test of this species. In the open coast form the gonads are occasionally broken up into a single, rather than double, row of separate sacs. Variations in the length of the branchial tentacles also occur and very small branchial tentacles have been observed in estuarine forms. These characters are variable, however, and cannot be regarded as constant differences between individuals from these two environments. The differences in the test especially appear to result from the individual's response to different sets of conditions, *viz.* the solid gelatinous pillar of test associated with firm fixation to rocky substrates and to adjacent individuals where wave action is strong; the development of long rooting processes fixing rounded solitary individuals in sandy substrates subjected to less turbulent conditions.

There has been considerable discussion in the literature on the relationships between the South African *P. stolonifera* and the Australian *P. praeputialis*. Hartmeyer (1911) suggested that the presence of a seventh branchial fold was exclusive to South African forms. There are, however, seven branchial folds on each side of the body in the present specimens from Ram Head and this character does not provide a distinction.

Nor can siphonal spines be used to distinguish subspecies. Michaelsen and Hartmeyer (1928) recognised the subspecies *P. stolonifera waia* from Western Australia with siphonal spines 0·09 to 0·1 mm long, and *P. stolonifera typica* from South Africa and *P. stolonifera praeputialis* from New South Wales (Heller's type specimen) with siphonal spines 0·02 to 0·024 mm long. The present specimens demonstrate a wide range in length of siphonal spine between 0·05 and 0·08 mm while the spines of typical specimens collected from Moreton Bay (Queensland) are 0·03 to 0·04 mm long. Spicules (branched) in the branchial sac of South Africa specimens occur in the present specimens from Victoria.

Millar (1963) distinguished the South African form from the Australian by the absence of a sunken area around the siphons and by the posteriorly directed dorsal tubercle opening. Some South African specimens (Millar, 1955) were also distinct in the presence of four test projections around the apertures. These differences, however, are not constantly expressed (Millar, 1966). In fact Cynthia *valdiviae* Michaelsen and *C. herdmani* Von Drasche (see Michaelsen, 1904), both from South Africa are identical with the Australian form in these characters and in others. Day (1974) has described the depressed area around the siphons in South African specimens. In Australian specimens, the collar of test around the siphons is invariably present when specimens are contracted (i.e. when preserved or exposed intertidally). It is probable that it is not present if individuals are not contracted. It was not observed by the present author in large *in situ* subtidal populations at Noosa (Queensland) in which the siphons of all individuals were fully extended in the feeding position. Day (1974) p. 36, has also observed variations in form for the South African populations that are identical with variations in the Australian forms, viz: "solitary specimens below tide mark are usually hemispherical . . . Specimens from S. African estuaries

which have root like extensions of the test to anchor them in the sand".

It is most probable, therefore, that in view of the general form of the body (and its capacity to respond to a wide range of environments) and the similarities between such features as the dorsal tubercle, the siphonal spines, and the occasional presence of branched spicules, that two separate species cannot be maintained.

Nevertheless, no test projections from the siphonal region have ever been observed in the many Australian specimens that have been examined; and the relationships are most reliably indicated by regarding the Australian and South African forms as separate geographic sub-species, morphologically distinguished only by a degree of variability of certain characters in the South African populations, which are not variable in Australian specimens, i.e. the absence of projections from the siphonal region (sometimes present in S. African specimens).

Pyura lepidoderma Tokioka

Pyura lepidoderma Tokioka, 1949, p. 10. Kott, 1966, p. 299.

New Records: Port Phillip Bay.
Distribution: Qd.: Hervey Bay. Japan.
Description: A single flattened specimen, basal diameter 1 cm, heighth 2 mm is available, fixed to a *Mytilus* shell. The siphons are on the upper surface and are almost sessile. The surface layer of test is marked off into polygonal scale-like thickenings that are most conspicuous around the apertures where they emphasise furrows along the short siphons. The body musculature consists of longitudinal bands from both apertures which cross one another on the body. There are six branchial folds on each side of the body with closely set internal longitudinal vessels. The liver branches off the gut in the pyloric region and divides into arborescent branches along its length. The gut loop is narrow and the anal border has shallow rounded lobes, the rectum turns anteriorly and is very short. The gonads, in the gut loop on the left and in a corresponding position on the right, consist of polycarp-like sacs along either side of common ducts opening at the base of the atrial aperture with the anus.
Remarks: Attention has already been drawn (Kott 1966, 1969) to the similarity between this species and the Antarctic *P. squamata* Hartmeyer (see Kott 1969, p. 136). The occurrence of the species in Port Phillip does to some extent satisfy the discontinuity in the records of the antarctic species and the north-eastern Australian Japanese species respectively. It is possible that further collecting will demonstrate that their ranges are continuous and that only a single species is represented.

Halocynthia hispida (Herdman)

Cynthia hispida Herdman, 1881, p. 61.
Halocynthia hispida; Kott, 1968, p. 77 and synonymy; 1972b, p. 189.

New Records: Western Port (Crawfish Rock; some on *Ecklonia* holdfasts; Eagle Rock).
Distribution: S. Aust.: St. Vincent Gulf; Tas.: Bass Strait, d'Entrecasteaux Channel, Maria Island; N. S. W.: Port Jackson. Ceylon; and off the west coast of North America and Japan. (see Kott, 1968).
Description: The present specimens demonstrate the range from the individuals covered with branched test tubercles to those in which there are no tuberculous extensions of the test. (see Kott, 1968).

Herdmania momus (Savigny)

Cynthia momus Savigny, 1816, p. 143.
Herdmania momus; Kott, 1972b, p. 189; 1972c, p. 255 and synonymy.

New Records: Western Port (Flinders Jetty, Eagle Rock).
Distribution: N. W. Aust. (Broome); S. W. Aust.; S. Aust.; Vict.; N. S. W.; Qd., Arafura Sea; Indonesia; Fiji; the Palau Islands; Tahiti; Japan; the Indian Ocean; the Red Sea; South Africa; and the West Indies. Kott (1972) has drawn attention to the lack of distinction between the Indo-Pacific populations of this species and those from the Atlantic, *H. momus pallida* (see Van Name, 1945). It is most probable, therefore, that *H. momus* is a circumtropical species extending into temperate regions in the southern parts of its range. i.e.

around the South African and south Australian coasts.

Description: The specimen from Flinders jetty is 20 cm long and completely invested with a colony of *Didemnum patulum*, leaving only the apertures free.

Microcosmus australis Herdman

Microcosmus australis Herdman, 1889, p. 23. Millar, 1963, p. 741; 1966, p. 373. Kott, 1972e, p. 53.
Microcosmus claudicans sub sp. *australis;* Michaelsen and Hartmeyer, 1928, p. 404 and synonymy. Kott, 1952, p. 288.
?*Cynthia solanoides* Herdman, 1899, p. 29.
?*Microcosmus solanoides*; Kott, 1952, p. 289.

New Records: Western Port (Crawfish Rock).

Distribution: see Kott 1972e

Remarks: There seems little to distinguish this species from *M. solanoides* Herdman except the siphonal denticles which Kott (1952) described as not curved and much smaller than those of the present species. Herdman's type specimen from Port Jackson is the only record of *M. solanoides* and it is likely that it cannot be separated from *M. australis.*

Microcosmus nichollsi Kott

Microcosmus nichollsi Kott, 1952, p. 290; 1972c, p. 245 and synonymy.

New Records: Western Port (Crawfish Rock, 8 metres, on *Ecklonia* holdfasts).

Distribution: S. Aust.: St. Vincent Gulf; Vict.: Flinders.

Description: Only a single specimen is available, 1 cm long. The surface is sandy and both apertures are anterior and almost sessile. The usual pockets or valves are present at the base of the atrial siphon, and the usual spines and scales are present in the siphonal lining. There are seven branchial folds on each side of the body with one or two internal longitudinal vessels between the folds. The gonads are separated into three blocks and on the left the most proximal section of the gonad crosses into the pole of the gut loop.

Microcosmus helleri Herdman

Microcosmus helleri Herdman, 1881, p. 54 Van Name, 1945, p. 349 and synonymy; Kott, 1972e, p. 54 and synonymy.

New Records: Western Port (Crawfish Rock, among *Ecklonia* holdfasts; Eagle Rock).

Distribution: W. Aust.: Cape Jaubert to Fremantle; S. Aust.: St. Vincent Gulf; Qd.: Great Barrier Reef, Gulf of Carpentaria, Torres Strait; Malaysia. Portugese East Africa (Michaelsen 1918). West Indies (Van Name 1945).

Description: The individuals are upright and more or less egg-shaped with a terminal branchial aperture and the atrial aperture about half way down the dorsal surface. Around each opening the test is produced into lobes which fold over when the aperture is contracted. Superficially the test is covered with long branched hairs that are obscured by a coating of sand which they enmesh. Beneath this sandy coating the test is very thin and brittle. There are four, very strong, tongue-like projections into the cavity of the branchial siphon at its base. There are three pockets at the base of the branchial siphon, formed by folds of the siphonal lining and these undoubtedly act as cuspid valves. There are six branchial folds on each side of the body. The dorsal tubercle is U-shaped with both horns turned in and completely fills a fairly shallow peritubercular area. The gut forms the usual narrow loop and in the pyloric region there are dense parallel glandular folds or lamellae, joined together by an external membrane, representing the liver. The long gonad on each side of the body is divided into three separate sections, and on the left crosses the intestine into the pole of the gut loop.

Remarks: The hard cartilage-like projections at the base of the siphon together with relatively small number of wide overlapping branchial folds characterise this species. The test lobes around the apertures are sometimes simple, but often are well developed, tuberculous or branched. In some specimens there is no coating of sand but externally the test is very hard and produced into pointed and sometimes branched papillae.

Microcosmus stolonifera Kott

(Figs. 44, 45)

Microcosmus stolonifera Kott, 1952, p. 291; 1972c, p. 245 and synonymy.

New Records: Western Port (Crawfish Rock).

Distribution: Previously recorded from Qld. (Moreton Bay) S. Aust. (St. Vincent Gulf) and Tas. (Tiny Is.).

Description: Posteriorly the test of these individuals is produced into an irregular root-like structure, sometimes long branched and sturdy, sometimes there is a double projection. Occasionally individuals are aggregated together. Both apertures are depressed into the upper surface and surrounded by a raised, rounded fold of test. The test is very hard, thin and stiff with a dense layer of embedded sand. There are overlapping curved spines lining the branchial siphon 0·06 mm long on their concave side but extending from a long base of about the same length. Short, irregular languets are sometimes present on the prepharyngeal band. The branchial tentacles have primary, secondary and minute tertiary branches. The dorsal tubercle is relatively small in the centre of the peritubercular area and has a simple, U-shaped opening, sometimes with a single horn turned in. There is a long, smooth-edged dorsal lamina. There are seven high and overlapping branchial folds on each side of the body, with 15-20 internal longitudinal vessels per fold and six to eight stigmata per mesh. The gut forms a narrow loop with liver lamellae in the pyloric region. Single rounded or sometimes irregular gonads are present on each side of the body. The gonad on the left is in the secondary gut loop and does not extend into the primary gut loop.

Remarks: The rounded fold of test around the upper surface enclosing the apertures is not always present and depends to some extent on the size of the individual. The species is distinctive, however, in the presence of the gonad outside the primary gut loop and in the size and form of the siphonal spines together with the high overlapping folds in the branchial sac.

Microcosmus squamiger Michaelsen

(Fig. 46)

Microcosmus claudicans sub. s. *squamiger* Michaelsen, 1928, p. 405.
Microcosmus squamiger; Kott, 1972a, p. 43 and synonymy.

New Records: Western Port (Crawfish Rock; Eagle Rock; Rutherford Channel). Port Phillip Bay (Mornington Pier, 9 to 35 metres, dense rock, vertical and horizontal clumps fixed to oyster shells; Williamstown, 5 metres, common on rocks).

Distribution: W. Aust: Shark Bay to Albany; S. Aust.: St. Vincent Gulf; N.S.W.: Port Jackson; Qd.: Bowen and Rockhamton. Red Sea. Undoubetdly there has been great confusion between this and related species (see Michaelsen and Hartmeyer, 1928) and it is probable that there is a wider distribution in the Indian Ocean.

Description: Rounded individuals are present in sometimes very large aggregates. The apertures are about one third of the body length apart and sessile. The animals are whitish to pinkish-brown, sometimes smooth, occasionally with some embedded sand. The surface is often very uneven and wrinkled, especially around the siphons. There are minute overlapping siphonal scales about 0·01 mm long. There are eight to nine overlapping branchial folds on each side of the body. The dorsal tubercle is always a double spiral cone, the gut forms a narrow loop, the gonads are separated into three sections and cross into the primary gut loop.

Remarks: This is a common species in those areas from which it has been recorded and is distinguished by the very small overlapping siphonal scales, the dorsal tubercle, the leathery test and the absence of a dense, sandy coating and the large number of overlapping branchial folds.

Molgula sabulosa Quoy and Gaimard

Ascidia sabulosa Quoy and Gaimard, 1834, p. 613.
Molgula sabulosa; Michaelsen and Hartmeyer, 1928, p. 449 and synonymy. Kott, 1972c, p. 248 and synonymy.

New Records: Western Port (Crawfish Rock, San Remo; Shoreham). Port Phillip Bay.

Distribution: Known only from Albany, (W. Aust.) and Port Phillip Bay (Vict.)

Description: Large spherical specimens with characteristic hollow test lobes formed around the apertures. The individuals often form

aggregates. The test is thin but stiff with adherent sand. The apertures are close together on the upper surface but are not in a depressed pit as in *M. mollis,* and do not have a thickened ridge of test extending along the dorsal line between them. Each aperture is surrounded by a rosette of hollow rounded lips of the test, 6 around the branchial aperture and four around the atrial aperture. These fold inwards over the aperture and each aperture together with its surrounding test projections, occupies a circular depression in the upper surface of the body. The body wall projects into these hollow lobes. The dorsal tubercle occupies the right hand side of the peritubercular area and there is elongate ganglion slightly to the left. The dorsal lamina is rather long. There are seven narrow branchial folds on each side of the body with only three internal longitudinal vessels, one on the edge of the fold and the other two ventrally. Stigmata are irregular between the folds and between the dorsal lamina and the first fold. The infundibula are tightly coiled and bifurcate in the summit of each fold. The gut forms a long narrow curved loop and the plain bordered anal opening is at the base of the atrial siphon. There are many fine longitudinal liver lamellae at the cardiac end of the stomach but at the pyloric end there are minute arborescent lobes. The kidney is long and curved on the right hand side of the body and the long tubular ovary extends parallel to its dorsal surface. Testes follicles are long narrow and deeply lobed at their outer edge tapering to the vasa efferentia at the end of the ovarian tube where they join into the short vas deferens that extends onto the mesial surface of the ovarian tube and opens to the peribranchial cavity there.

Remarks: This species is distinguished from *M. mollis* by the short vas deferens (which in some specimens is turned anteroventrally), by the longer dorsal lamina and by the hollow lobes of test that protect the apertures.

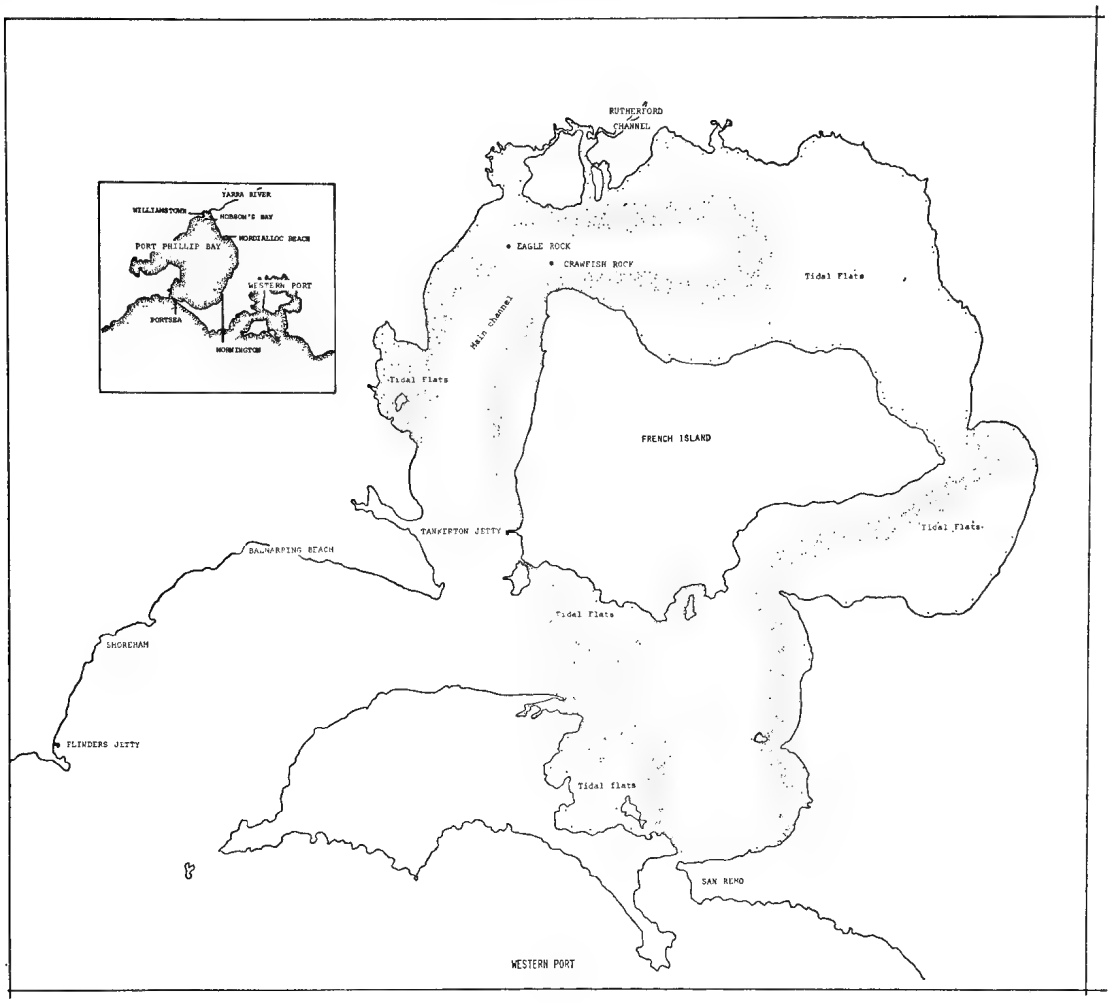
Mogula mollis Herdman

Mogula mollis Herdman, 1899, p. 54; Kott, 1952, p. 298; 1964, p. 144; 1972a, p. 45 and synonymy. *Mogula sabulosa; Kott,* 1972a, p. 190, 1972d, p. 248.

New Records: Western Port (Crawfish Rock).

Distribution: S. Aust.: St. Vincent Gulf; eastern Australia to Indonesia.

Description: The specimens are smaller than is usual for *M. sabulosa* and are laterally flattened and covered with delicate hairs to which sand adheres. There are small test projections around the apertures but these are not hollow as in *M. sabulosa.* The apertures are close together on the upper surface of the body both sunk deeply into the surface, with a ridge of slightly thicker test between them along the dorsal line. The apertures are directed away from one another. The body wall has very strong muscles in the siphons and around the anterior part of the body at the base of the siphons but posteriorly the musculature is weaker. The branchial folds are broad, overlapping and deeply curved and the dorsal lamina is very short. There may be as few as 4 internal longitudinal vessels on both sides of each fold. The gut forms a long, very deeply curved loop which enclosed the gonad on the left side of the body. At the cardiac end of the gastric region there are short transversely oriented liver lamellae but at the pyloric end there are longer and longitudinally arranged diverticulae. The testis follicles are grouped around the proximal end of the ovarian tube. They are long narrow and wedged shaped in outline, converging to paired ducts which join into a long vas deferens that extends along the middle of the mesial surface of the ovarian tube and opens at the base of the oviduct. On the right side of the body the testis lobes are accommodated in the curve of the kidney and not anterior to it as in *M. sabulosa.*



47—Map of region.

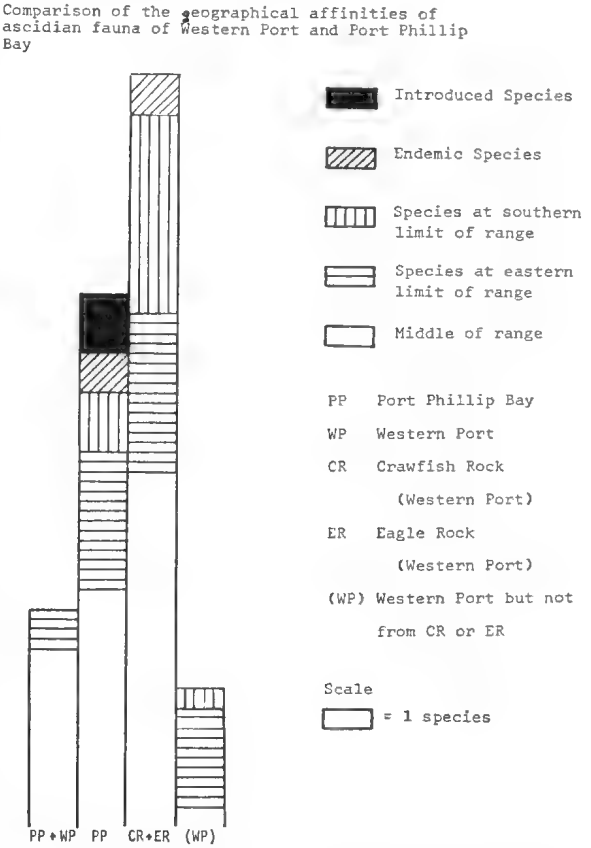
CHARACTERISTICS OF THE ASCIDIAN FAUNA (Fig. 48)

Most collecting of the Victorian ascidian fauna has been done in either Western Port or Port Phillip Bay. It is probable that a proportion of the very large number of species recorded from these two locations also occur on the open coast where a relatively limited range of habitats has been sampled.

The material reported on by Millar (1966) from Port Phillip Bay was collected by bottom sampler and the species taken represent the fauna of the sea floor. Kott (1952, 1957, 1962, 1963) reported largely on intertidal collections; while the present mainly subtidal collections have been taken manually from rock ledges, caves and from the sea floor and represent the larger components of the benthic fauna.

There are 26 species that have been recorded from Port Phillip Bay but do not occur in Western Port. Three are probably introduced (viz. *Ciona intestinalis; Ascidiella aspersa:* Kott, 1952; and *Styela clava:* Holmes, 1976). *Ritterella assymmetrica* Millar, 1966 and *Protopolyclinum sabulosa* (Millar, 1963) are endemic to Port Phillip Bay. Of the remaining 21 species, 12 are within their Australian range; and 7 are temperate species at the eastern or northern extremity of their range (including *Polycitorella mariae;* Millar, 1963, previously recorded from South Africa and New Zealand). For only three of these species does their occurrence in Port Phillip represent the southern limit of their range on the eastern coast of Australia.

There are 45 species that have been recorded from Western Port but have not been taken from Port Phillip. Twenty four of these are recorded only from Crawfish Rock and at no other location and a further 10 occur only at the adjacent Eagle Rock or at both Eagle Rock and Crawfish Rock. Of this 34 species one is endemic *(Polysyncraton victoriensis* sp. nov.); *Dumus areniferus* previously known only from New Zealand is recorded from Australia for the first time; 16 are in the middle of their range; eight are at the southern limit of their range and eight are at the eastern limit of their range. Of the species that are also recorded from other parts of Western Port three are in the middle of their range, five are at the eastern end of their range and three are at the southern end of their range (Fig. 48; Tables 1, 2).



48—Histograms showing geographic affinities of the Western Port and Port Phillip Bay ascidian fauna.

TABLE 1

Geographical affinities of ascidian species from Port Phillip Bay*

Species	Geographical affinity
Ciona intestinalis	Introduced
Protopolyclinum sabulosa (Millar, 1963)	Eastern limit
Polycitorella mariae; Millar, 1963	S. Africa; N.Z.
Distaplia viridis; Kott, 1972a	Eastern limit
Distaplia stylifera; Kott, 1972b	Middle of range

Cystodytes dellechiajei; Kott, 1972b	Middle of range
Ritterella assymmetrica Millar, 1966	Endemic
Euherdmania australis; Kott, 1972b	Middle of range
Aplidium solidum; Millar, 1963	Southern limit
Didemnum lambitum	Eastern limit
Perophora hutchisoni; Millar, 1966	Middle of range
Ascidia gemmata	Middle of range
Ascidia aclara; Millar 1963	Middle of range
Ascidiella aspersa; Millar 1966	Introduced
Corella eumyota; Knott, 1972a	Middle of range
Oculinaria australis; Millar, 1966	Eastern limit
Botrylloides magnicoecus; Millar, 1966	Middle of range
Polyandrocarpa lapidosa	Southern limit
Polycarpa pedunculata; Millar, 1966	Middle of range
Cnemidocarpa etheridgii	Middle of range
Styela plicata; Millar, 1966	Middle of range
Styela clava; Holmes, 1976	Introduced
Astereocarpa cerea; Millar, 1966	Eastern limit
Pyura fissa; Millar, 1966	Northern end of range
Pyura albanyensis	Middle of range
Pyura lepidoderma	Southern limit

* A recent reference is given for each species not discussed above.

TABLE 2

Geographical affinities of ascidian species from Western Port*

Species	Crawfish Rock	Eagle Rock	Other location in Western Port	Port Phillip	Geographical affinities
Podoclavella cylindrica			X		Eastern limit
Oxycorynia pseudobaudinensis n. sp.	X				Eastern limit
Eudistoma pyriforme	X				Middle of range
Polycitor giganteum; Kott, 1972b	X		X		Middle of range
Atapozoa mirabilis			X		Eastern limit
Sycozoa cerebriformis	X		X		Middle of range
Sycozoa pedunculata			X	X	Middle of range
Pseudodistoma cereum	X				Middle of range
Dumus areniferus	X				Single Australian record
Polyclinum marsupiale	X				Middle of range
Aplidium australiensis Kott, 1963			X		Eastern limit
Aplidium parvum Kott, 1963			X		Eastern limit
Aplidium pliciferum; Kott, 1972a			X	X	Middle of range
Aplidium depressum	X		X		Southern limit
Aplidium lobatum	X				Southern limit
Aplidium triggiensis	X				Eastern limit
Aplidium opacum Kott, 1963			X		Middle of range
Synoicium hypurgon	X				Middle of range
Sidneyoides tamaramae	X				Southern Limit
Didemnum moselyi	X	X			Middle of range
Didemnum patulum	X	X			Middle of range
Didemnum turritum	X	X			Eastern limit
Didemnum augusti	X				Eastern limit
Didemnum roberti	X	X			Eastern limit
Didemnum spongioides	X				Middle of range

Species	Crawfish Rock	Eagle Rock	Other location in Western Port	Port Phillip	Geographical affinities
Didemnum skeatii	X	X			Southern limit
Didemnum candidum	X				Middle of range
Trididemnum cerebriforme	X				Middle of range
Trididemnum cyclops		X	X		Southern limit
Lissoclinum fragile		X			Southern limit
Lissoclinum ostrearium	X				Southern limit
Diplosoma translucida		X			Southern limit
Diplosoma rayneri	X				Middle of range
Polysyncraton orbiculum	X				Eastern limit
Polysyncraton victoriensis n. sp.	X				Endemic
Phallusia depressiuscula			X	X	Middle of range
Ascidia sydneyensis	X	X		X	Middle of range
Symplegma viride	X				Middle of range
Amphicarpa diptycha	X			X	Eastern limit
Botrylloides nigrum	X	X		X	Middle of range
Botrylloides leachii	X				Middle of range
Polycarpa thelypanes			X		Southern limit
Pyura australis	X				Eastern limit
Pyura cataphracta	X				Southern limit
Pyura irregularis	X	X	X	X	Middle of range
Pyura scoresbiensis			X		Eastern limit
Pyura stolonifera praeputialis		X		X	Middle of range
Halocynthia hispida	X	X			Middle of range
Herdmania momus		X			Middle of range
Microcosmus australis	X				Southern limit
Microcosmus nicholisi	X				Eastern limit
Microcosmus helleri	X	X			Middle of range
Microcosmus stolonifera	X				Middle of range
Microcosmus squamiger	X	X		X	Middle of range
Molgula mollis	X			X	Southern limit
Molgula sabulosa			X	X	Eastern limit

* The most recent reference is given for each species not discussed above.

It is probable that both Port Phillip Bay and Western Port provide different habitats for ascidian species since only a small group of species (the majority of these well within the limits of their geographic range) have sufficiently unrestricted habitat requirements to be present in both locations. Larger numbers of species are recorded from either Port Phillip Bay or Western Port but not from both. The most striking differences in the biogeographic affinities of the ascidian fauna at these two locations is the high diversity of species and the high percentage of northern forms at the southern limits of their range that occur in Western Port. These differences are not associated with a random distribution of habitats since the majority of species have been taken at Crawfish Rock and also at adjacent Eagle Rock and have not been recorded at more southerly locations in Western Port. Both these stations are in the northern section of the bay, where there is complete protection from oceanic swell and where extensive tidal flats draining into the main channel may modify the temperate marine environment. This may contribute to the diversity of environmental conditions that support such a diverse fauna with such a high proportion of northern species.

The most diverse assemblage of species has been taken from Crawfish Rock, on a 30° slope of soft brown coral and occasional sandstone boulders. The species are largely encrusting aplousobranch forms with vivi-

parous larvae but there are also small leathery oviparous stolidobranch species that produce root-like structures and form aggregates. The stalked species *Pyura australis* only rarely occurs here, and large stolidobranch and phlebobranch forms *(Phallusia depressiuscula, Herdmania momus, Cnemidocarpa etheridgii,* etc.) that require smooth and firm surfaces for fixation are not present.

The turbidity of the water and its effect on the light intensity at greater depths does not appear to limit ascidian distribution at this location.

Similar, though not such dense nor diverse associations of species occur at Eagle Rock and in the Rutherford Channel.

It is possible that the less diverse fauna of Port Phillip Bay is a result of environmental disturbance. The presence there of (probably) introduced species *Ciona intestinalis, Ascidiella aspersa* and *Styela clava* (see Holmes, 1976) may be evidence of this disturbance.

The occurrence of *Dumus areniferus* Brewin, previously known only from New Zealand, increases the number of temperate species that are known to occur in both southern Australian and New Zealand waters (Kott, 1974). It is unlikely to have been introduced on ship's hulls and its Australian occurrence may have previously been overlooked.

STATION LISTS

WESTERN PORT

CRAWFISH ROCKS, tidal currents, 5 knots

? metres:

Aplidium triggiensis
Trididemnum cerebriforme

Intertidal:

Microcosmus squamiger
Microcosmus australis

0-15 metres:

Sycozoa cerebriformis
Dumus areniferus
Aplidum lobatum
Sidneoides tamaramae
Didemnum skeati
Didemnum spongioides
Amphicarpa diptycha
Pyura irregularis
Halocynthia hispida
Mogula mollis

8 metres, *Ecklonia* 'holdfasts':

Aplidium lobatum
Didemnum candidum
Didemnum mosleyi
Didemnum patulum
Polysyncraton victoriensis
Botrylloides leachii
Pyura australis
Pyura cataphracta
Pyura irregularis
Halocynthia hispida
Microcosmus helleri
Microcosmus nichollsi
Microcosmus stolonifera
Microcosmus squamiger

12 to 24 metres:

Oxycorynia pseudobaudinensis
Sycozoa cerebriformis
Eudistoma pyriforme
Polycitor giganteum
Pseudodistoma cereum
Synoicium hypurgon
Polyclinum marsupiale
Aplidium lobatum
Aplidium depressum
Didemnum moseleyi
Didemnum patulum
Didemnum turritum
Didemnum augusti
Didemnum skeati
Didemnum spongioides
Didemnum roberti
Polysyncraton orbiculum
Lissoclinum ostrearium
Diplosoma rayneri
Ascidia sydneyensis
Botrylloides nigrum
Symplegma viride
Amphicarpa dytycha
Pyura australis
Halocynthia hispida
Microcosmus helleri
Microcosmus stolonifera
Microcosmus squamiger

13-26 metres:

Amphicarpa dipytcha
Pyura australis

EAGLE ROCK, 15 metres:

Trididemnum cyclops
Didemnum mosleyi
Didemnum patulum
Didemnum turritim
Didemnum roberti
Didemnum skeati
Lissoclinum fragile
Diplosoma translucidum
Ascidia sydneyensis
Botrylloides nigrum
Pyura irregularis
Pyura stolonifera praeptialis
Halocynthia hispida
Herdmania momus
Microcosmus helleri
Microcosmus squamiger

RUTHERFORD CHANNEL, fast current, 5 metres:

Sycozoa penduculata
Aplidium depressum
Microcosmus squamiger

TANKERTON JETTY, 7 metres:

Polycitor giganteum
Atapozoa mirabilis
Sycozoa cerebriformis
Aplidium pliciferum
Phallusia depressiuscula
Pyura irregularis

SHOREHAM:

Ascidia syneyensis
Molgula sabulosa

SAN REMO:

Pyura scoresbiensis
Molgula sabulosa

BALNARRING BEACH:

Podoclavella cylindrica

FLINDERS JETTY, 3 metres:

Oxycorynia pseudobaudinensis
Podoclavella cylindrica
Tridemnum cyclops
Lissoclinum ostrearium
Phallusia depressiuscula
Ascidia sydneyensis
Polycarpa thelypanes
Herdmania momus

PORT PHILLIP BAY

WILLIAMSTOWN, 5 metres (common on rocks):

Ascidia sydneyensis
Microcosmus squamiger

HOBSON'S BAY, 13 metres:

Didemnum lambitum
Ascidia sydneyensis
Phallusia depressiuscula

MORNINGTON, 12/10/69, bottom patchy, rock and sand, coll. Kevin Duke, 1-2 metres:

Pyura albanyensis
Pyura stolonifera praeputialis

MORNINGTON PIER, 12/10/69, sparse rock, calm waters, coll. Kevin Duke:

Ascidia gemmata
Cnemidocarpa etheridgii

MORNINGTON PIER, 12/10/69, dense rock, coll. Kevin Duke, 8-11 metres:

Pyura irregularis
Microcosmus squamiger

YARRA RIVER, 0-3 metres, 28/4/72, No. 3 Oil Wharf, Coll. J. E. Watson.

Ciona intestinalis

PORTSEA, 15/9/1957:

Amphicarpa diptycha

MORDIALLOC BEACH, Nov, 1888, Coll. W.K.:

Aplidium pliciferum
Botrylloides nigrum

ZOOBENTHOS SURVEY, Fisheries and Wildlife Department, Coll. G. Poore: Off BRIGHTON, 21/10/69, Station 906, sandy bottom, 10 metres; middle of northern part of Gulf, 10/2/69, Station 915, silty-clay bottom, 19 metres; off GEELONG, 12/2/70, Station 940, silty clay bottom, 8 metres:

Ascidia sydneyensis

South of POINT WILSON, 12/2/70, Station 942, silty clay bottom, 7 metres:

Ascidia sydneyensis
Molgula sabulosa

North-west of PORT ARLINGTON, 11/2/70, Station 930, silty clay-sand bottom, 10 metres:

Ascidia gemmata

North of PORT ARLINGTON, 18/2/71, Station 931, silty sand-shell bottom, 15 metres; north-west of ROSEBUD, Station 982, sandy bottom, 18 metres:

Sycozoa pedunculata
Cnemidocarpa etheridgii

East of ST. LEONARDS, 16/2/71, Station 960, sandy bottom, 10 metres:

Moluga mollis

Off BRIGHTON, 9/3/71, Station 1218, sandy bottom, 4 metres:

Pyura lepidoderma
Pyura stolonifera praeputialis

Off BRIGHTON, 9/3/71, Station 1226, silty-clay bottom, 8 metres; half-way down eastern shore of the Bay, 10/3/71, Station 1241, sandy bottom; south of SOUTH WERRIBEE, 11/3/71, Station 1252, sand-gravel bottom, 4 metres:

Pyura stolonifera praeputialis

PORT PHILLIP SURVEY:

area 5, POPES EYE, 15/5/63:

Polyandrocarpa lapidosa

area 30, PRINCE GEORGE LIGHT:

Pyura Stolonifera praeputialis

ARTIFICIAL REEF:

Ciona intestinalis
Sycozoa pedunculata
Ascidia syneyensis
Botrylloides nigrum

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MORTUARY CUSTOMS OF NORTHEAST ARNHEM LAND: AN ACCOUNT COMPILED FROM DONALD THOMSON'S FIELDNOTES

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'If a man could but follow all that takes place when a *yarkomrri* [important] man dies he would understand almost all of the culture of these people.'—Fieldnotes, July 29, 1937.

On learning of a man's death close female relatives throw themselves on the ground and hit their heads with knives, bone points or sticks, until blood flows. Some close male relatives may weep and the son of the dead man is likely to become angry and aggressive towards his father's enemies. Like the son, the actual sister's son may also become angry, recalling past quarrels in which his mother's brother had figured, regardless of whether he had been in the right or wrong. Distant male relatives in the camp at the time of death sit quietly with bowed heads.

The wife of a deceased man usually sits down beside him, places the head in her lap and with her left arm around the body cries all day. At night she may lie beside him surrounded by other camp members who weep and sing through the night. The songs indicate the path the deceased's spirit, *birrimbir,* should take.

If people bring news of a death to a camp they do not announce the name of the person but only mention that somebody has died. A senior man in the group then sings a song formally announcing the death and at the end of the song identifies the person and indicates the cause of death without using their name.

BODY PAINTING

Most deceased people are painted with a clan design, *mintji.* The design painted on the body should be and usually is that belonging to the person's own clan. However, absence of the right people may mean that the clan design of the actual MM clan is used. Once painted the design must not be seen by women or children so the painting is often carried out at the edge of the camp and when the painting is completed the corpse is covered with paperbark, only the face being left bare. Young men who see a clan design for the first time have underarm sweat, *bunggan wurdoi,* of an older man, rubbed over their eyes.

The body is first rubbed with red ochre and then painted by one or two men, preferably of the opposite moiety to the deceased, who are good hands at painting, *kong mintjimirri* The most frequently chosen relatives are from the categories FZS, MBS, ZS, MB and MF/FMB. If the painters are of the same moiety they are likely to be close WMB, ZDS, or FZDS but never actual F, B or S. Whoever they are, they are referred to as the *kong wukundi,*[2] hands tabu from death, and after they have completed the painting coat their arms and hands with red ochre, eat apart for about a week, refrain from sexual intercourse and do not go near water. They lived with their wives some distance from others in the camp. The *kong wukundi* and their wives cook all their food in a sand sculpture (*wandjur*—discussed below) and put all their food scraps into another.

Case 1. Body painting (see Plate 4). An old Obulkarra [Wulkara of Warner, see 1958: 46] woman died at Milingimbi on Sept. 19, 1935. She had been declining for some months and was very thin from the effects of leprosy. As she was old there was very little crying, but Thomson was suprised at the apparent indifference of all the immediate relatives. The day following the death a Wunguri clansman who called the deceased *mukkulmal* (FZ) and a Tjambarapoingo man who called her *momalkor* (WMM) painted the body.

The painting was carried out under the shade of a big tree about fifty yards from the camp. The husband and a few other men came to and from the place at which the body was painted from time to time. Ordinarily her husband would have assisted in the painting but he was too old and could not see properly. The brothers of the deceased, as is always the case, could not touch the body. At the conclusion of the painting the *kong wukundi* painted their hands and arms below the elbow with red ochre and that night held a *mantjarr* ceremony. This took place on the fringe of

the camp. A sand sculpture, *wandjur* (see below) representing the clan well of the deceased was moulded on the ground. The sculpture was associated with the edible corm of *Eleocharis dulcis*, called *rakai*, but the significance of this was hard for Thomson to follow at the time [as he had only just arrived in Arnhem Land]. The men sat around the sculpture singing for an hour or two, and then the women danced behind them. A fire was lit in the centre (*manotji* [literally eye but also used of a certain kind of well]) of the sand sculpture. Leaves were then heated in the fire by a man whose mother came from the 'Wulkarra [that is Obulkarra] side'. All the immediate relatives gathered inside the sculpture about the *manotji*, and a 'big' man *dalkarramirri*, called out in loud voice:

'Kurita!' (fire).

'Ye'h-' replied the participants, with a long hissing shout.

Fire was called because the ancestral woman, *mialk kortjurino*, burned the grass to clear the ground while looking for *rakai*.

The participants then shouted *'Wap wap! wap!'*, the sound of the fire burning.

The *dalkarramirri* then called out a series of big names with the participants answering 'Ye'h!' to each.

'Nunimarra!' (big name [of fire?]).

'Baltjau'wuma' (a big light made by fire flaring up in thick grass).

'Matauwupuptum' (leaping tongues of fire).

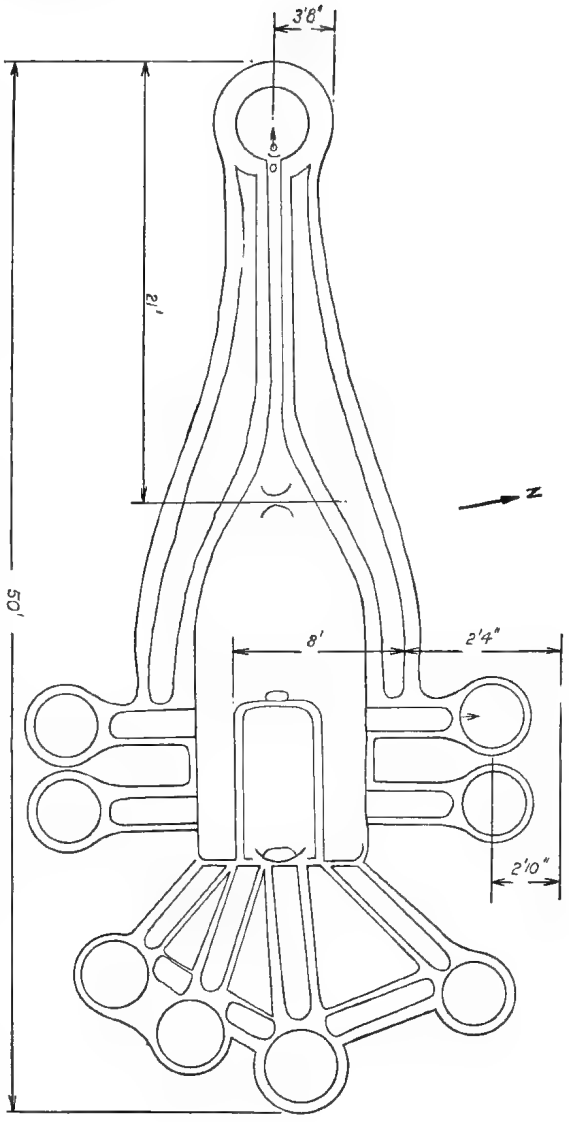
'Birraudun' (cleansed by burning).

Throughout the calling leaves were being heated in the fire and used to strike the bodies of the people standing in the sculpture. After use they were burnt in the fire and to the accompaniment of singing, smothered with earth, 'that *mialk* [woman] walk about now—come along clean place'.

Then the men sang of *marramatta*, a rodent that followed the fire and established itself in the plains after the burning; and then of dog (*workan*) who smelt the rats; and after that of plain cockatoo (*Corella* sp.) *kai karra*.

The ancestral woman now looked about for the *rakai*. Next the men sang of mist (*kardany*) which is like fine smoke; then of a spider making its [nest/webb?] in the damp grass. The last song was about the wind that follows the time of burning the countryside.

Close relatives are not free from all tabu until after a second cleansing ceremony.



HAIR

Before burial of the body all the head hair is pulled out by the *kong wukundi*. The beard is also pulled out with the aid of hot bees wax. The hair is kept in a basket and sometime during the following weeks is sent by the *kong wukundi* to a fairly distant relative of either moiety to turn into a string decorated with feathers, *marngarai* (Kopapoingo, Tjambarapoingo and Koiyamillilli) or *yiritpal* (Wunguri). The maker of the *yiritpal* or *marngarai* rubs red ochre on the hair as soon as he receives it

An Obulkarra woman being painted with a clan design after death (Case 1).

and is given a present of vegetable food from the *marramorkoimirri* (the deceased's patriclansmen). Usually the maker is of the opposite moiety to the deceased but he does not have to be; common choices are people in the category of MF/FMB, MB, MBS, WMMB. One to two years later it will be completed and returned to the close kinsmen of the deceased eventually being given to his son, if adult. A large presentation is made to the maker; this formerly included vegetable food, cycad bread and hooked and short spears. The string is then used as a belt to be worn in *ngarra* ceremonies and during fights and *makaratta* peace-making settlements. Eventually the string is cut up to form the 'arms' of men's sacred baskets.

BURIAL

Either the same day as the painting or the day afterwards the body is buried. There are two types of burials: either in the ground or in a tree.

A grave, *molo* (referring specifically to the heap of earth covering the grave) is usually 1 m deep and long enough for the corpse to lie extended, on its front. There seems to be some variation of opinion as to which way a deceased man's head should point. In a discussion on the matter a Djinang and a Liagallauwumirri man maintained it should be towards the clan well while a Kopapoingo and Tjambarapoingo man maintained it should be eastwards.

If a body in a grave is covered with heavy logs and stones it usually signifies that it is to be left for good and there is no one to carry the bones about so that the bones will not be removed. There is no belief as to any ill result to the spirit from this practice. Usually, however, the bones are expected to be dug up. In this case the body is covered by a sheet of paperbark, the earth replaced and poles and stones placed on top to stop dingoes, lizards or dogs eating the flesh. If a camp dog does eat the flesh it becomes *wukundi*, and may be killed. If it is not killed it will be put through a cleansing ceremony and any food that the dog catches before the cleansing can only be eaten by a male owner of the dog. Even after the restriction has been removed the wife of the owner or other women will have to make a ceremonial presentation of food to the *marramorkoimirri* as soon as she eats food the dog has killed.

A grave may be located in one of three places. Where the deceased is a child, it is often buried in the camp of the parents who sleep beside the grave until exhumation. If it is an adult the body is usually buried outside the camp, but it may may be in it if the people plan to abandon camp immediately.

In the southeastern part of the Murngin area around Blue Mud Bay there is the third kind of location: the collective burial ground.

Case 2. Visit to communal burial ground. On October 18, 1935, Thomson visited a communal burial ground or *wukundi* place at Blue Mud Bay. It was situated on the edge of Marrakulo territory at a place called Mange'yall, 5 km from the Aborigines' camp. [Warner (1958: 49) refers to the people of this area as Marungun and notes that their 'waterhole' and 'country' are called Mangaia which he glosses as 'stench of a dead man'.]

A Marmariny man had died some 2-3 weeks earlier. His body had been taken to this place and put on a platform. The platform stood about 1·50 m high with the body upwards and roughly covered in paperbark. The ground around the platform was sculpted into a *wandjur* pattern. The body was sharing the platform with a number of other bones from skeletons, most of which were covered with red ochre. In this case the head of the body was placed towards the east so that the *malli* [shade or shadow] could go to Buralko [the land of the dead].

On this day Thomson visited the burial ground in the company of five men: Raiwalla, his Mildjingi companion; Taudauongo, the actual elder brother of the deceased; an old Ritarango man; Djimbaron, a Dai'i man; and Marrilyanwi, a Marmariny clansman who called the deceased son and had been one of the *kong wukundi*. The other *kong wukundi* were Liawulpul a Bidingal man who called the deceased *du'wai* (FZS) and Marakuri a korrong of the deceased (FZDS).

The party set out from the camp travelling across salt pans. A line of fires was burning in the short grass between the camp and the burial ground. As the grass was sparse and short and provided neither food nor cover for the animals this was surprising. On enquiry it was found that the fires had been lit to 'block in *wukundi*—might be smell go all round', i.e. to cut it off from the camp to which it is believed to be more or less connected by smell. When the party was within 0·50 km of the place the Aborigines requested Thomson to leave the water he was carrying lest the *malli* [shade] of the *wurkaidi* (larvae ancestor) might 'go into it and make

(him) sick (*rerri*) . . .'. They translated the term *rerri*, generally used for sickness of any kind, as leprosy.

None of the Aborigines carried spears or spear-throwers which was most unusual; this was said to be one way of helping to avoid sickness. As they neared the spot, Marrilyanwi took charge. Thomson was told not to stay too long or go too close lest he should fall sick. They all approached the platform by a roundabout path to take them upwind. They conversed in whispers and walked slowly with the arms folded to avoid being 'flash'. The little outcrops of stone that appeared on the flat salt pans were carefully avoided. A couple of hundred yards off they halted and Marrilyanwi rubbed his hands under his armpits and then over Raiwalla's arms and legs before kneeling down and biting his knees and shins all the way down. Marrilyanwi then spat or hissed in the direction of the *wukundi* place. He did the same to Thomson. When they moved off Raiwalla was told to walk behind Marrilyanwi in his footsteps. When they reached the platform they looked briefly and then moved away and turned their backs while Marrilyanwi approached the platform and smashed a pipe close to it in order to pacify the *malli* so that it would not follow them. 'Chuckit smoke along him, that's all', explained Marrilyanwi. They left and the Aborigines washed in a salt pan a few hundred yards off. 'Wash'em sweat, ground, that maggot him bite you and me—*malli*— you and me no been see that *malli*', one of them commented.

On October 24, Thomson visited the burial ground again with a Ritarango man, Wuruwul, who had not been there before. Raiwalla and Thomson did not have to go through any of the procedures of the previous visit, although they did approach upwind again. Wuruwul, a stranger to the place, was very fearful of sickness, particularly because he was somewhat fat. As a precaution against sickness he had his knees and elbows bitten (see Plate 5) and left the area well before the rest of the party.

The alternative to ground burial is exposure on a platform, either built in a tree and called *djamba* or free standing like the kind used in house building and called *katauwurro*. [Warner states (1958: 433) that the body on a platform is placed face up so that when the adominal wall breaks the intestines will not fall.] Thomson found that although this was true for the eastern half of the area the people to the west of the Ritarango place the body on its front.

The choice of burial mode depended on several factors. Small children and old people were usually put in the ground and active people in their prime, male or female, were placed on platforms where the flesh dries more quickly and the bones become cleaner. If a person were killed in a *miringo* raid they were usually put in a tree by their relatives so that the people could leave the area immediately.

There is a third mode of disposal found among the Burara who Thomson reports as eating young men, women and children, after roasting in ashes [although Thomson did visit the Burara it is not clear how much of the following information was obtained by talking with and observing Burara people and how much was supplied by their Glyde River neighbours who hold the Burara in low esteem].

The dead are eaten by all relatives with the exception of M and MB because the 'two fella been carrim along *bindji* [belly]'. Bodies to be eaten have an incision made in their left side through which the viscera are removed. The liver is eaten but the heart, penis and vulva are dried and carried in a special small basket (*pulupur* in Burara) or in a *matjitji* to increase hunting effectiveness. The lungs and stomach are buried.

Because the body is eaten the western Burara do not paint it, although the eastern Burara, under the influence of their western neighbours, the Wallamango and Yarnango, do. These latter groups rarely eat their dead but do inspect the internal organs, for signs of sorcery such as sores (*tjitji*) on the kidney, heart or liver, by making an incision between the crest of the ilium and the last rib on the left side. Now that there are *marngit* medicine men in the area—a new tradition from the south [see Thomson 1961]—the people no longer perform this kind of investigation.

POSSESSIONS

The Djinang speaking peoples pull down the deceased's hut and eventually set fire to it when the bones have been exhumed. The main possessions of a person, such as his spears or a canoe he has made, are treated throughout the area in the same way as people. They are symbolically cleansed at a *mantjarr* ceremony and in the case of canoes rubbed with red ochre often on two separate occasions. If a man has been speared, his possessions are broken and pieces given to his relatives in camp which an informant interpreted as 'that mean I push all these people go for fight'. Each piece of broken possession used in this way is called *maidjaballa*.

Wuruwul having his elbow bitten as a precaution against sickness prior to visiting the communal burial ground in Blue Mud Bay (Case 2).

If a person does not want to fight he makes a new dilly bag and gives it back to the man (usually the elder brother of the deceased), who distributed the *maidjaballa*. The broken pieces are given most frequently to relations in the categories MF/FMB, MMB, FZS, MBS, ZS.

If a person dies from a cause other than spearing his possessions are also broken up and distributed to various other residential groups where there are close relations of the deceased. These possessions are then used in the cleansing ceremonies.

Thomson reports a case where following the death of an important man a restriction was placed over a large area of land.

> *Case 3. An area of land placed under restriction.* While at Katji [on the mainland south of Milingimbi] camp in January 1937 Thomson noticed red blazes on the trees along the path to Derby Creek. These were to free the area about the Katji River from a restriction that had been imposed at the death of an important man.
>
> The restriction had been imposed at the death of Raiwalla's father-in-law [Raiwalla, a Mildjingi clansman, was Thomson's guide and friend] because of his influence when alive and because he had spent much of his life in that area. The restriction was not removed until after the *bukubut* [exhumation ceremony], when the trees were painted and a fire lit to burn off the grass and cleanse the area—both literally and figuratively. The fire was started by burning his old camp with a fire of ironwood. After the burning off the women went out and collected root foods in the area and brought them back to the son and brothers of the deceased. If any outsider eats food from the area while the country is under the restriction the close relatives resent this and try to kill the offender by sorcery or with an actual war party (*miringo*). Such restrictions do not apply in remote areas but only when important people (*yarkomirri*) die in the vicinity of an important camping place. The death of the wife or daughter of an influential man can also lead to the same restriction Tjambarapoingo, Kopapoingo and Ritarango peoples have the same custom.

CLEANSING CEREMONIES AND GROUNDS

Cleansing ceremonies of the kind described in Case 1 are held at several stages following death. After burial the clan song cycle of the deceased is sung about a circular sand sculpture and all men, women and children present, together with the larger possessions are dusted with heated leaves (*mantjarr*) to drive the *malli* (shade) of the deceased away, to render the hunting weapons effective and the other possessions safe to handle.

At a second ceremony of similar form the participants throw pieces of the deceased's possessions into the fire burning in the small depression which forms the focus of all the cleansing ceremonies at this stage. At this second stage the women usually dance while the men are singing the clan cycle.

A week or two later the third cleansing ceremony, called *bukulup* (forehead-washing), is held. The small circular sand sculpture used in the previous ceremonies now gives way to a much larger and more elaborate representation of the clan well. Starting in the early hours of the morning the men sing the clan songs and then once the sun is up the close relatives, male and female and the *kong wukundi*, wash standing in the well and rub red ochre over themselves. This ritual frees the *kong wukundi* from all tabus. The patriclansmen make a presentation of food to members of the opposite moiety.

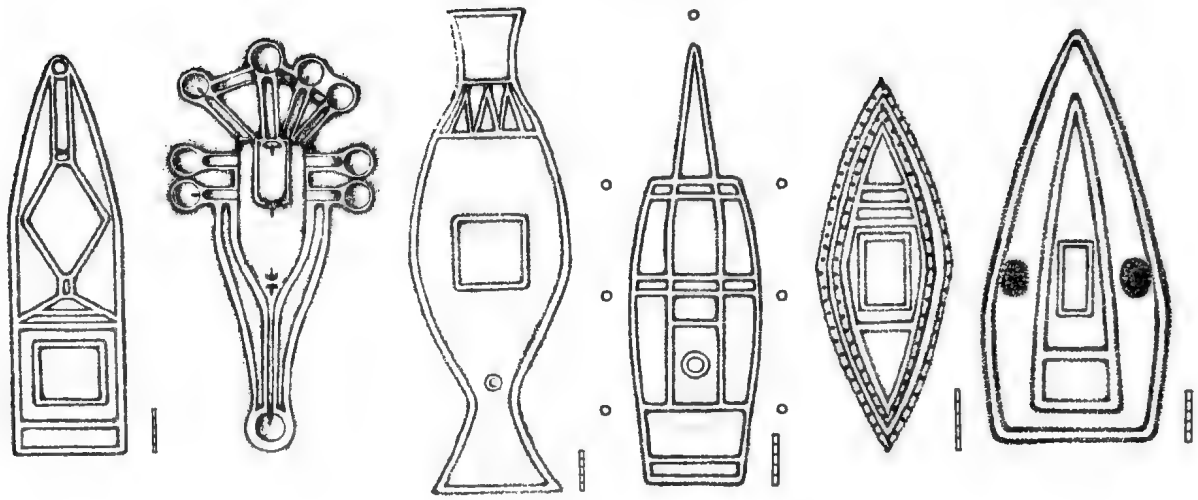
The sand sculptures are also used in two other contexts. Most frequently in the curing of sores or wounds but also around graves and burial platforms (see Case 2). Several clans may share the use of a particular design and a single clan may have several designs relating to different places with differing degrees of importance. Figure 1 shows sketches of six grounds seen in use by Thomson.

EXHUMATION AND FLESH DISPOSAL

After a month or two the bones are exhumed. The men who perform this task are also known as *kong wukundi* [possibly also as *kong djok*] but are not necessarily the same people who buried the body. They may be of either moiety, with the reservation that a man may not assist in the exhumation of his siblings.

The grave is usually dug out either with bare hands or with a sharpened stick. Among the Djinang speaking groups only males are present at the grave. One will sing and another play the digeridoo. Among the people to the east, women are present at the exhumation and dance while the men sing.

The treatment of the flesh varies with the kind of burial and the area. Among the peoples



SOME *WANDJUR* SAND SCULPTURE DESIGNS

(Running from left to right and top to bottom)

1. Marango clan (dua moiety) *wandjur* representing the bee hive *yarrpain* [referred to as 'long-nose sugar bag' in Aboriginal English on account of the relatively long entrance tunnel]. The central circle represents the eye of the clan well; the rectangle surrounding the well and the area immediately above it is referred to by the sacred name *bambula*. The small rectangle had a pole 483 mm tall erected in it, called *warrinman*, representing an ancestral hero. The ground was used on July 24, 1937, at Milingimbi for the cleansing of two small girls. The same design may also be used by Tjambarapoingo speaking clans.
2. Birkilla clan (*yiritja moiety*) *wandjur* representing the bee hive *birkurda* at a place called Yarrakka in Arnhem Bay. The small circle at the end represents the entrance (*ngorro*—nose) of the hive. [This *wandjur* should be compared with the illustration published by Thomson in the 'Illustrated London News' for February 25, 1939, page 294.] This ground is the most elaborate form of the *wandjur* and only used for important men; others have a simplified, but recognizably similar, version. The ground was used on August 7, 1937, to cure a Birkilla/Kopapoingo man with a sore.
3. Birkilli clan (*yiritja* moiety) *wandjur* representing *waitjura* [? a fish]. The piles of white sand are sores (*tjitji* or *mapan*) made by a crab (*mirriya* or *katjirri*). The location referred to is Karraparra in Blue Mud Bay and the design is also used by Yituwa clansmen of that area. The ground was used on August 7, 1937.
4. A *dua* moiety *wandjur* used by Liagauwumirri. Maiyarrmaiyarr and other Tjambarapoingo speaking groups united by the track of the Djanggauwo sisters. The ground represents springs left by the sisters whether they thrust the 'yam' sticks into the ground. The springs are called *milmindjarrk* [and are marked by being freshwater sources in areas of salt surface water. The arrows appear to indicate the direction of flow of the waters beneath the wells]. The ground was used on July 30-31, 1937, at Milingimbi for a Maiyarrmaiyarr man who was drowned when a canoe turned over during a storm in the Cadell Straits. There were six people in the canoe: two men escaped but a blind man and a second man [it is not clear which was the Maiyarrmaiyarr man] with his son and daughter were drowned because they were encumbered with turtle hunting gear. The ground measured 15 m overall.
5. Kolumalla clan (*dua* moiety) *wandjur* representing *mar'ndi* [?] The ground was outlined in white sand and used on August 14th, 1937.
6. Warramirri clan (*yiritja* moiety) *wandjur* representing a whale, *woimirri*. The small circle is the rectum above the tail. The central rectangle is both the whale's stomach and the *manotji* or eye of of the clan well. The soil forming the outline was raised up 100-125 mm and whitened with sand. This ground was used on August 14 and 15, 1937, to cure a child of the Wunguri clan who had sores. The child's full MMB came from the Warramirri clan.

east of the Glyde River, including the Kanalpingo and Djinba, flesh from a grave burial is put back into the ground. Flesh from a platform burial is placed in paperbark and left in a forked tree nearby to be destroyed naturally. The platform itself is pulled down and buried in the sand sculpture in which it was standing.

Among the Djinang, Mildjingi, Balambi, Wullaki, Burara and all groups westward of the Glyde, the flesh is kept and at the *bukubut* ceremony placed in a special hollow log called *larkan djammurmur.*

Case 4. Larkan djammurmur form of flesh disposal. Early in the morning of November 11, 1936, the Wullaki group at Katji started to sing in preparation for a *bukubut.* The Wullaki people were joined by some Milli'ereng clansmen because the dead woman's mother was of this clan.

The body had been buried in the ground. A few days earlier it had been exhumed and the flesh roughly stripped from the body and wrapped in a paperbark bundle. The bones were in a second bundle. The men had then cut a tree for the *larkan* [coffin] and the women collected cycad nuts for a food presentation. While the cycad nuts were being leached the *larkan* was fashioned and a *marraidjirri meri* (an effigy of an ancestral spirit) made. The preparation of the *larkan* included singeing it, cutting the spikes on one end, and painting it. On the morning of November 11, 1936, the men were seated in the shade of a clump of trees some distance from the camp with the *larkan.* The bundle of flesh was apparently [this not unequivocally clear in the notes] already inside the coffin. The wrapped bones and a *marraidjirri meri* called Kanangalkngalk were also nearby. This ancestral spirit was responsible for the people using a log coffin.

An informant explained that in the distant past (*millegidji*) there were spirits (*meri* or *morkoi*) that were neither animals nor men and who still live in the bush today. These spirits were never men but a race of their own. One of these spirits, Kanangalkngalk, is still alive today and some Wullaki people even claim to have seen him in the monsoon forest. Kanangalkngalk has two wives and some children, none of whom is a threat to the people like the spirits of deceased human beings. The *marraidjirri meri* represent Kanangalkngalk.

They say that in the distant past Kanangalkngalk cut down a hollow tree. The tree fell and as it fell water started to pour out of it. He tried to hold onto the log as the water flowed out but his fingers slipped and the log moved off like a fish. The log cut the ground as it went allowing the water to flow. Along the way the log heard a *buralla* [publicly used bull-roarer) sing out. Then, perhaps because the water told it to, the log went underground at Katji carrying earth and water with it as it went. The log wanted to go down towards the sea but found the ground too hard so it came back and let the water go. From the end of the Katji lagoons, where he turned back, there is no deep water but only transient flood waters at the end of the wet season. The log came back to Katji and decided to stay where the deep pool is beside the camp. At that place he gave himself a name: the log said, 'I am *djammurmur larkan.*' The people today reflect on the fact that they take fish, water snakes (*Hypsirhina*) and wild taro from Katji where the *larkan* walked around. That is why they paint them on the log coffin and cut the long 'fingers' into the mouth of the log, representing the jagged end which resulted from it breaking the ground and making Katji River.

The men around the *larkan* began to sing a song about the *wullawarri* fish drawn on the log. Then they picked up the log and danced with it, making short lunges and rushes, replacing it on the ground at the end of each movement. (See Plate 6.) The log was then erected on the open ground near the camp and the *marraidjirri* and bones were carried toward the camp by two old men. The dance that followed was called after the spirit, Kanangalkngalk *meri.* The main body of men danced forwards looking for the *meri* carried by an old man, who represented the male spirit. The one who carried the bones represented a female *morkoi* [spirit] [Kanagalkngalk's wife?]. The first old man kept dancing forward with the *meri* to reassure himself that the other man had the bones.

The women danced their slight shuffling dance from one foot to another on the fringe of the dance area. The dance concluded with an old man, *dalkargrining* [*dalkarramirri*] calling the big names of the *maraiin* of the deceased and of her country. Then the bones were handed over to the actual younger sister of the woman's mother, the real mother having died. As she received the bones in their bundle the *marraidjirri meri* was placed on top and she walked off with the whole lot.

At a later date the string on the *marraidjirri meri* is removed and made into *ngaimbak* [arm bands] and used in decorating a *bati giwillir* [a kind of men's basket]. This basket is then presented to the man who made the string. The conclusion to the *bukubut* comes sometime later. A presentation of food is made to the *kong wukundi* by the close relatives of the deceased, usually the F. *duwe* (either FZS or D), MB and EB if it is a man that has died but not in the case of a woman.

This food is not eaten by the full F or MB but FEB and FYB, *duwe* and *kalli* (MBS/D) do share in it.

In the past the Djinang people removed the flesh from the buttocks, washing it free of the soft and more putrid surrounding flesh and tied it up in paperbark. Later these parcels of flesh were cooked outside the camp, wrapped in grass and paperbark and hung around the neck to increase hunting effectiveness. Some people would go a step further and soak the flesh in a mixture of honey and water and then nibble a fraction with their eyes closed.

The bones are washed and wrapped in paperbark, of if the flesh is not entirely removed, left exposed in a forked tree. During the 1-2 weeks before the *bukabut* ceremony the bones remain outside the camp and may not be seen by the women.

The *kong wukundi* camp apart for several days. The wetter the body the longer the period of restriction. If it is particularly sloppy the men eat with a bone point (*pringal*) or any sharpened stick because the fluids will have penetrated their finger nails making them smell for some time.

A day or two after the exhumation the *kong wukundi* participate in a cleansing ceremony singing all night and washing in the morning in a sand sculpture. After washing they cover themselves in red ochre. Several days later they have a clan design painted on them which releases them from all restrictions.

Case 5. Exhumation. On January 13, 1937, the bones of a Djinang man named Lamieri, *dua* moiety, buried at Gillere in Millierieng territory were exhumed (see Plate 7).

Only a few people went to the area of the grave where the man had been buried 6-7 weeks before. Those not directly involved in exhumation stood upwind of the grave.

Two men were involved in handling the bones. The man who removed the bones was the adopted father of the deceased from the same country [i.e. clan] named Balambarri. He was assisted by Makani a Mildjingi man a 'ZS' of the deceased, who was married to two of his daughters.

On the way to the grave there was some discussion as to whether the body was soft enough yet to make the removal of the bones easy. The grave itself was unmarked except for a plain circular sand sculpture near the head of the grave and a heap of wood lying on top to keep the dogs off. The body was about 1 m below the surface, lying face down on a layer of grass and completely extended. The grave itself was in loose, well-drained sandy soil about 90 m from a creek. The soil was removed largely with bare hands but use was made of a canoe paddle that happened to have been in the camp and brought along.

An old clansman of the deceased, a classificatory F, sang to the accompaniment of clapsticks. In Kopapoingo and Tjambarapoingo ceremonies women are present and dance during the exhumation but not among the Djinang. The *kong wukundi* examined the body to see that the flesh was sufficiently decomposed and finding it was, the assistant, Makani, went off to get some water in a paperbark trough.

The deceased had been an old man of not much standing so he had not had a clan design painted on his chest.

The adopted father removed the bones, starting from the feet and working upwards. Makani poured water over the bones as the first man washed them thus reducing the period he would be wukundi [tabu]. The head was picked up last and washed by pouring water in through the *foramen magnum*. Each bone as it was picked up was placed on a sheet of bark beside the grave. When they had all been removed the grave was filled in again. The two men washed and smeared themselves with white paint from head to foot: 'everybody no more want to smell'. Red ochre is only used in the final cleansing. During the night a sand sculpture 1·60 m in diameter was made at Makani's camp and a ceremonial washing called *bukulup* carried out on the following morning (see Plate 8). About sunrise the two *kong wukundi* washed by pouring water over one another's bodies and then smearing red ochre all over themselves, their spears and spear-throwers and immediate possessions. This freed the men and their weapons from tabu.

It is usual to wait two or three days before holding this ceremony, but as the camp was breaking up on the following day it was completed straight away.

MARRAIDJIRRI MESSAGE STRINGS

Marraidjirri is the general term for a class of decorated strings whose most common use is in the mustering of people for exhumation and final disposal ceremonies (see Plate 9). *Marraidjirri* strings differ from *marngarai* strings in that although many of them incorporate hair of a dead person they are largely made of fibre string and are used in a different way, (for *marngarai* strings see under 'Hair' above).

Each clan has its own *marraidjirri* forms representing totems associated with the clan (see Table 1). Generally there are several forms of the string-like *marraidjirri* which are classed together as *bogongo* and spoken of as 'small' in contrast to the elaborate figure emblems such as that mentioned in Case 4 which are referred to as big (*yindi*).

Besides being used to gather people for mortuary ceremonies they are also associated with circumcision ceremonies, the social development of children and love magic. In circumcision ceremonies they are used to gather people. The second usage result from the first occasion on which a small child picks up any natural object such as grass, a shell, fruit or small lizard and gives it to to its parents. This object is then tied into a small bundle and sent off to an acquaintance both geographically and socially distant. This

Wullaki men taking the *larkan* coffin to the camp for erection (Case 4).

The exhumation of a Djinang man (Case 5).

Ritual washing in a *wandjur* sand sculpture of two of the men who participated in the exhumation shown in plate 4 (Case 5).

On August 20, 1935, this messenger, a man of the *yiritja* moiety arrived at Milingimbi wearing a *dua* moiety *marraidjirri* message string. He had come to call the people to Elcho Island for the final disposal of the bones of a Tjamborapoingo man.

person fashions the object into his own clan's large *marraidjirri* and presents it to the child's parents in a large public ceremony. The parents then make a payment of traditional wealth of considerable proportions to the maker of the *marraidjirri*. On completion of the ceremony the string is removed from the core about which it is bound and made into arm bands or used for adorning certain kinds of men's baskets (*bati mindjalpoi*). Some *marraidjirri* strings may be used in love magic after they have been used in one of the foregoing ceremonies A sweetheart or errant wife is believed to be impelled to follow the man involved when the *marraidjirri* string is looped over her hands.

The strings sent out to muster people for ceremonies are really representations of big (or proper) *marraidjirri* constructed around wooden or sometimes paperbark centres and used at the *bukubut* (see Case 4). These solid emblems look like *rangga* (the secret totemic emblems) as an informant observed to Thomson, but may be seen by women and children and are said to represent the clan's ancestral *morkoi* or spirit being. This *morkoi* is different from the clan's ancestral hero, *wangar*. However, as with the clan totem, the string covering is called *buyu* and is equated with flesh; in its broadest sense it just means covering. The core is regarded as *maraiin* (sacred) and identified with the bones of the skeleton.

TABLE 1

Some of the small *marraidjirri strings* (*bogongo*) used by various groups

CLAN/GROUP	NAME and DESCRIPTION
Wanguri	Yorko—a round root called *Kalun* in Kopapoingo (*Cissus carnosa*) Komulo—the great billed heron
Birkilli	Ku'ak—a small bird Yukuwa—the root food *Vigna vexillata*
Tjambarapoingo	Tjarrak—a tern (*sterna* sp.)
Kanalpingo	Kalliwur—a large white lily
Liagallauwumirri Mandalpoi	Wititj—Snake
Ritarango	Ku'ak—a small bird
Durrilli	Malka—bee (*Trigona* sp.)
Obulkarra	Yorko—round root (*Cissus carnosa*)
Mildjingi	Kurungur—a small cloud and also the wild bean *Ipomea pes-caprae*

BUKUBUT FOLLOWING EXHUMATION OF BONES ONLY

When the food for the *bukubut* ceremony is ready, a week or two after exhumation a classificatory ZS goes into the bush and picks up the bones. Meanwhile the *marramorkoimirri* prepare the ground, known by different names to different clans:

Liagallauwumirri	call it	*birlimbil*
Djeranggoikoi	,, ,,	*djirrkurul* (of *bulmantji* or shark)
Birkilli	,, ,,	*yallandu* (from Bukunda, a place)
Mildjingi	,, ,,	*manitji*

When the 'ZS' carrying the bones, approaches the ground just outside the camp where the ceremony is to be held, the men begin to sing. The *marramorkoimirri* and a great crowd of more distant kinsmen dance around with spears poised and jab these at the bones in their paperbark wrappings as they lie in the sand sculpture. 'Him want spear that one, open him—*wangar* (totemic ancestor) been do.' Not all clans carry out the ceremony in this way. The western ones, Liagallauwumirr, Mildjingi and Djinang only sing.

The Birkilli, Daigurgur, Ritarango and allied groups customarily spear the parcel, and do the same again when they are holding the final disposal ceremonies. They open the paperbark with the spears and then sit down and wash the bones before placing them in a new wrapping, and hanging them from a forked stick standing in the middle of the sand sculpture. At this stage the women and children may not see the bones although they can later on when they have been red ochred.

From the late afternoon onwards through the whole night the men sing and complete the *bukubut* ground where the bones will be presented to the woman who is to carry them. This is usually the actual FZ, EZ, adult D, or mother if the deceased is a young child. If the bones of an older person are given to a mother it is always to a classificatory mother; they are never in the custody of a sister

although she may handle and carry them. In the morning these relatives and the MM will dance near the song group which is usually composed of EB, YB, F. The bones are then handed to the MF/FMB, ZH or MMB. Most commonly, it is to the ZH who, then hands the bones to the deceased's FZ who will carry them during the following weeks.

Previously the F, S, ZDS and ZS of the deceased will have made a bark container, *tarra,* decorated with the deceased's clan design for the bones to be carried in. The Mildjingi and Liagallauwumirri do [may?] not have this custom. There is then a ceremonial presentation of food by all the helpers in the various stages of the ceremony to the *marramorkoimirri.*

Often the skull is not placed in with the other bones but carried separately by WB or another ZH. The bones are carried for 1-5 weeks. At the end of this period they are again hung from a forked stick in camp and only moved on shifting camp, until the final disposal of the bones in a hollow log coffin ceremony.

Case 6. A Wullaki bukubut ceremony. A *bukubut* ceremony at which the bones of a dead *Wullaki* speaking man of *yiritja* moiety were handed over to the deceased's sisters was held at Katji on October 3 and 4, 1936.

When Thomson arrived in camp late in the afternoon the ceremony was about to begin. The bones were hanging in a small shade (*kurngan*) along with the *marraidjirri meri.* The *marraidjirri* represented a wasp's nest called *barral* and was decorated with a picture of the little green pigeon, *work'miringo* (*Chaleophaps chrysochlora*). This bird is associated with the paper wasp in areas of monsoon forest.

Although the deceased man was Wullaki the *bukubut* was carried out with a Mildjingi song sequence because the Wullaki relatives had handed the bones to the Mildjingi [Thomson has Raranggal *malla* at this point in his notes, but on the first page he equates Mildjingi *malla* with Raranggal *malla*] clansmen as a friendly compliment.

The ceremony began with singing to the accompaniment of clapsticks and didgeridoo and continued for some hours into the night until everybody was supposed to be asleep. Each man then seized a torch of lighted paperbark and started to dance, first encircling the shade with the bones and *marraidjirri* in it, and then moving into the camp crying *berk! berk! berkberk ko ye'h ko ye'h.*

They encircled the whole camp where everyone pretended to remain sleeping and then trotted back in single file to the shade. This was the dance of the flying fox. The singing then continued. When they began the song about the jungle fowl (*gullauwurr*) the men started to dig a long serpentine path, which eventually measured 42 m, from the shade to the point where the men constructed a representation of the bird's nest. At intervals the men working on the road and the nest cried out *kurrkun kurrkun djue wurak—grr'rr* in imitation of the jungle fowl; these cries were heard intermittently through the night. In making the nest mound the men imitated the movements of the bird by crouching low.

Early in the morning the *marraidjirri* was brought out (see Plate 10). The first dance was the wasp dance. While most of the men danced, two of their number darted out towards a man who held the *marraidjirri* at arm's length on a spear-thrower and pretended that they were being attacked at the wasp's nest. The men were meant to be looking for yams in the monsoon forest and to be driven back by the wasps. The women danced at some distance with the common rhythmic shuffle known as *luku wankain 'ngorro.* When the dancers reached the jungle fowl nest at the end of the path they called out the big names associated with the deceased. These were both the deceased's *maraiin* (sacred) names and those of the Mildjingi clan. As the calling finished the bones were handed over by the deceased's WB (Bulambirri) to the dead man's full sisters. [They would not be the custodians of the bones].

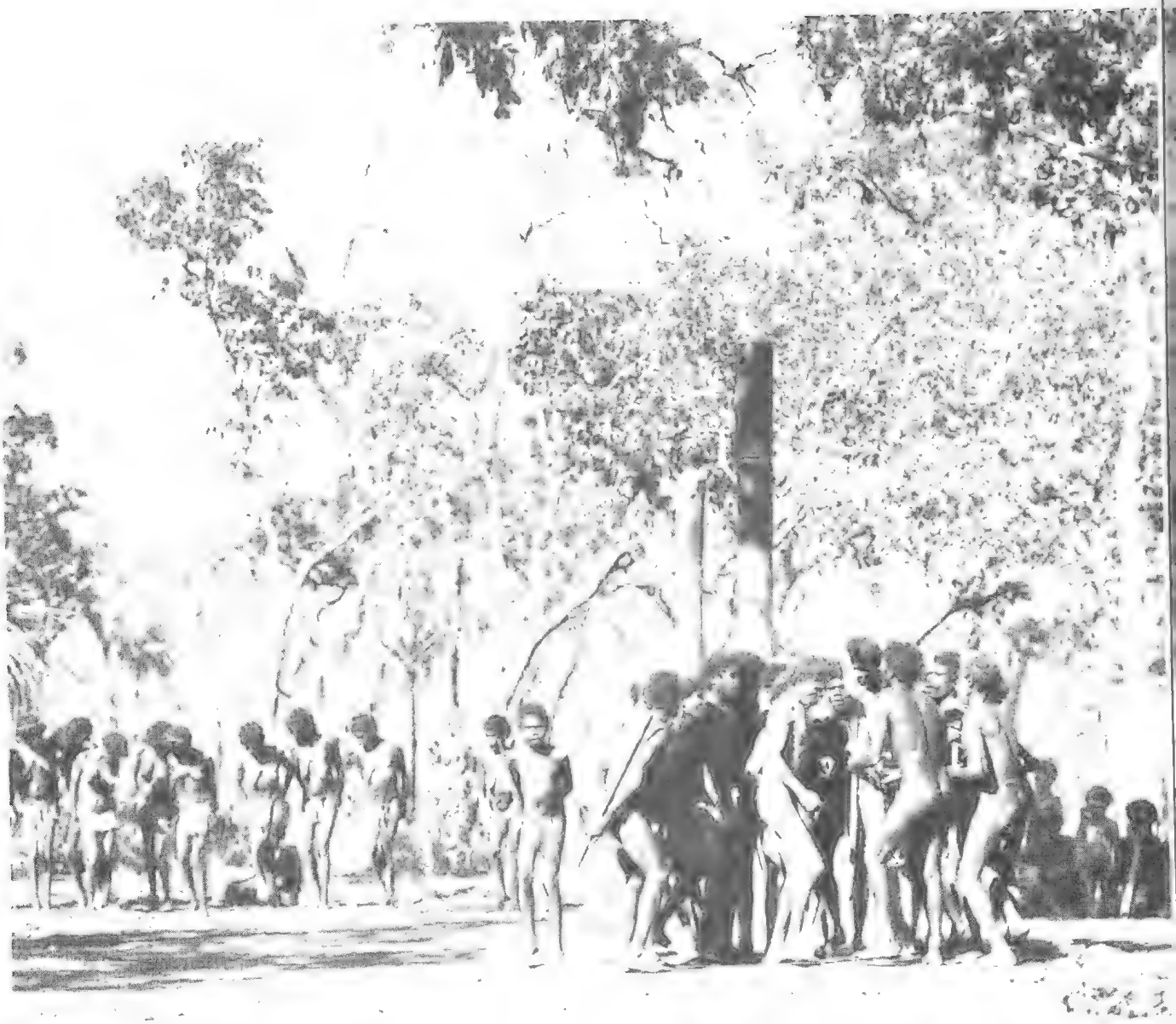
During the period in which bones are carried they are thought to indicate the approach both of news bearers and of revenge parties. If the bones make a light tap against the bark container this indicates the approach of a person with news of some kind. If the tap is loud it announces the approach of a war party.

Once or twice before burial in the hollow log coffin, the bones are taken out of the *tarra* and red ochred and this may be associated with the change of *tarra* too. After the second red ochring the mother may become custodian of the bones. This painting with red ochre removes *wukundi* from the woman who carried the bones intially.

HOLLOW LOG COFFIN

The holding of the final ceremony is decided in this way. The father or his brother, asks the relatives carrying the *tarra* whether they are ready to make the coffin. If they agree preparations are made for the ceremony. Frequently the relatives carrying the *tarra* feel the need to make an excuse to agree and say that they are ready because they have carried the bones for a long time without help from anybody else. The coffin is made by F, EB, YB and

Dancing with a wasp emblem in a Wullaki *bukubut* (Case 6).



A hollow log coffin ceremony in Arnhem Bay, 1937.

MMB, all members of the deceased's patrimoiety.

Hollow log coffins collectively referred to as *dupan* (hollow) differ in size, ranging from 1.25 to 4.50 m. and different clans call them by different names (see Table 2).

TABLE 2

The names used by different groups for their hollow log coffins

CLAN/GROUP	NAME
Ritarango	
Mandjikai	Wurrwurr
Birkilli	Djallumbo—associated with a wading bird found on the salt pans
Tjambarapoingo	Daimirri—a hollow log thrown by an ancestral hero into the sea and transformed into a hollow stone outside Buckingham Bay
Liagauwumirri	Mululu
Liagallauwumirri	Bardaru—Associated with the crow and the milky way
Marango	Kallangurr
Kanalpingo	Larradjadja
Mildjingi	
Warramirri	Kapalla—associated with the funnel of a steamer and the blowhole of a whale
Tjapu	Larrakit

However, all are made in the same way. A tree which has been hollowed out by termites, is cut and cleaned by burning. A circle is incised 300-600 mm from the top end and two small holes cut diagonally opposite each other 50-75 mm from the top. The circular incision is called *derong* and always painted yellow on *yiritja* coffins and *red* on *dua* coffins. The two holes are called eyes and serve to commemorate the fact that the coffins were originally made by each clan's spirit ancestors and in some way personify them.

After the coffin has been shaped it is moved into a large shade where the men work on painting it. As the painting nears completion the people gather for the final ceremony. Each evening there is singing and dancing. On the final morning the bones are taken from the *tarra* and covered with red ochre. The skull is then painted with the clan design. The coffin is brought out and placed at an angle with one end supported on a forked stick. Inside a sand sculpture of the clan well a close male relative of the deceased, often a *korrong* (FZDS) or *moralkor* (MMBS) breaks the long bones and the skull before placing them in the log. Finally the log is erected (see Plate 11).

The bones of several people of both moieties may be placed in the same coffin. The coffins are left standing, eventually decaying and disappearing without trace.

References

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Notes

[1] The Donald Thomson Ethnographic Collection was donated to the University of Melbourne by Mrs Thomson following the death of her husband in May 1970. By agreement the University has lent the Collection to the National Museum of Victoria where it is now housed.

The principal purpose in preparing this paper for publication is to draw attention to the ethnographic riches of the Collection. No compilation of notes can do justice to the vision that informed the fieldwork nor create the interpretive synthesis that Thomson had in mind. Inevitably the immense ethnographic detail of the fieldnotes can now be appreciated only by a series of scholars who will be able to breathe interpretive life into different aspects of the many but unintegrated details that characterize all fieldnotes.

This introduction to the Arnhem Land section of the Collection has been built on Thomson's notes for a paper on 'Kopapoingo Death and Mourning Rituals'. Within the general framework of the notes I have added descriptions from his fieldnotes as case studies. The presentation of both the text and the cases has been kept as close to Thomson's own wording as possible, but some alteration has been unavoidable in the process of converting fieldnotes to continuous prose. Further the notes cover several years and during that time Thomson's understanding of the language and life underwent substantial changes. In particular, his spelling of words in the local languages altered, so I have standardized on the later forms. A number of details in the cases and in particular those associated with the *wandjur* sand sculptures, have had to be omitted since the meaning was obscure and there was no simple way of setting out the information, some of it possibly deriving significance from its location on the page and its position relative to other notes. Undoubtedly a scholar with particular knowledge of some of the clans' religious life would be able to make sense of some of the notes that have been omitted. For this reason any person working intensively on a paricular aspect of the mortuary customs described here or on the details of symbolism in the life of a paricular group will have to consult the notes themselves where they will find the odd word or phrase that may be of significance to them. I have enclosed substantive additions to the text by myself in square brackets.

I received permission to prepare the paper for publication from Mrs Thomson while organizing the cataloguing of the ethnographic collection on a grant from the Australian Institute of Aboriginal Studies. Work on the preparation of this paper has been made possible by an appointment as senior Associate in Aboriginal and Oceanic Ethnology in the Department of History in the Faculty of Arts of the University of Melbourne. I am most grateful for the help I have received from Mrs Thomson, Margret Darragh, Gregory Dening, Alan West and Nancy Williams. Special thanks are due to Judith Wiseman for her unflagging assistance in all things connected with the Collection.

[2] It is uncertain whether this usage of *wukundi* is *correct*. The primary reference is to places associated with death that are tabu in some way (see Case 2). Thomson appears to have extended the meaning to cover other tabus associated with death.